Fish Surveys of Shields River Tributaries: 2001 through 2003

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Dedication

This report is dedicated to Wally McClure, a colleague, friend, and champion of fishery resources. Wally passed away in 2003 after a battle with cancer. Wally was the Fisheries Biologist for the Gallatin National Forest and he was instrumental in obtaining funding to ensure that this survey work was completed as well as helping to conduct field surveys.

Executive Summary

This report documents the results of aquatic surveys conducted in many of the Shields River tributaries from 2000 through 2003. I employed a systematic survey design to sample all tributaries that entered the Shields River from the west, up to and including Potter Creek, at 0.8 km intervals. At 3.2 km intervals I conducted depletion fish population estimates and detailed habitat surveys. Thermographs were placed in most of the sampled streams to document summer water temperatures. I also re-sampled fish survey sites that had been sampled in 1974 to document changes in fish communities that had occurred over time. Drought conditions that persisted within the Shields River basin from 2000 through 2003 may have influenced species distributions and abundances.

Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*; YCT) were captured in almost all sections that supported trout, but were generally more abundant in middle and upper reaches of tributaries. YCT were distributed throughout most of the basin. Genetic sampling found that most of the remaining YCT populations either had no evidence of introgression, or very slight levels of introgression with rainbow trout (*O. mykiss*). Rainbow trout were primarily restricted to the lower portion of the Shields River and Cottonwood and Brackett creeks. I suspect that rainbow trout originated from early stockings into Brackett, Cottonwood, and Daisy Dean creeks and the Shields River; however, rainbow trout can probably access the Shields River from lower source populations, particularly from the Yellowstone River, due to recent changes in a suspected upstream migration barrier, Chadborne irrigation diversion, that probably now allows limited upstream movement by large rainbow trout.

Brown trout (*Salmo trutta*) are widely distributed throughout the Shields River and in the lower portions of most of its tributaries. They also extend relatively high into the Rock, Brackett, Bangtail, Cottonwood, and Flathead drainages. Brook trout (*Salvelinus fontinalis*) were found in the upper portions of the Canyon, Brackett, and Flathead Creek drainages, throughout the Bangtail, Rock, Cottonwood, and Horse Creek drainages, through much of the upper Shields River above Wilsall, Montana, and in several headwater tributaries. Distributions of brook trout and YCT overlapped considerably. Mottled sculpins (*Cottus bairdi*) were found throughout most of the drainage, but their distribution appeared to be restricted from the highest elevations. Suckers (white, *Catostomus commersoni*, and longnose, *C. catostomus*) were found in the lower portions of Willow Creek, Brackett Creek, Cottonwood Creek (above Wilsall, Montana), Potter Creek, Horse Creek, and Chicken Creek. Longnose dace (*Rhinichthys cataractae*) were restricted to Cottonwood Creek (above Wilsall, Montana), lower Potter Creek, and lower Chicken Creek. Columbia spotted frogs (*Rana luteiventris*) were seen in the Willow Creek, upper Flathead Creek, and Falls Creek drainages, while northern leopard frogs (*Rana pipiens*) were seen in the upper Brackett and lower Dugout Creek drainages.

Brook trout appeared to be continuing to invade stream habitats within the Shields River basin and they appeared to be displacing YCT at several locations. A distinct spatial relationship was observed for brook trout invasion as recent brook trout invasions were found in the lower portions of several upper Shields River tributaries from the South Fork Shields River upstream. Brook trout appeared to be making up an increasing proportion of the trout communities

throughout much of the drainage. It appeared that contribution of brook trout to the fish community in lower Shields River tributaries may have stabilized, but brook trout appear to be continuing to make up progressively higher percentages of trout communities in middle and upper tributaries. No clear relationship was found between brook trout invasion and water temperatures. I speculate that brook trout invasion is not controlled by physical factors, but is more related to time and that brook trout will ultimately invade all streams where they have physical access. Rainbow trout made up less and YCT comprised more of the fish community in Cottonwood Creek, probably a result of discontinued stocking of rainbow trout in this stream. Brown trout appeared to displace brook trout in Rock Creek. While trout were found in lower Horse Creek in 1974, no trout were found at the same sample site in 2003.

Aquatic habitats were generally in good condition in most tributary streams; however, the lower portions of many tributaries were found to have extremely low flows due to both irrigation withdrawals and drought conditions experienced during sampling. Impacts from livestock grazing along stream channels were widespread, but only severe at a few locations. Many locations appeared to have been impacted by past livestock grazing, but some of these areas appeared to be recovering from these past impacts. Road and timber harvest impacts to stream channels were also observed at several locations. High levels of fine sediments were found in many of the streams; however, the sources of these fine sediments were often difficult to identify. High water temperatures were recorded at many sites and high temperature may be limiting trout in some locations.

Table of Contents

List of Tables

List of Figures

Introduction

The Montana Cooperative Fishery Research Unit and the Fisheries Special Projects Bureau of Montana Fish, Wildlife and Parks (FWP) was asked by Region 3 of FWP and the Gallatin National Forest to conduct fish surveys in tributaries to the Shields River, Montana, particularly west-side tributaries, to document the presence and status of Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*; YCT). Previous fish surveys have been conducted in Shields River tributaries (Berg 1975; Workman 1976; Clancy 1985, 1987; Shepard 1991; Tohtz 1999), but other than Berg's (1975) study, no systematic survey of tributary streams has been completed. I conducted surveys during 2001-03 in cooperation with Region 3 of FWP and the Gallatin National Forest to develop a conservation plan for YCT in the Shields River drainage (Tohtz, in preparation).

Study Area Description

The Shields River drains approximately 117,000 ha and flows into the Yellowstone River approximately 10 km east of Livingston, Montana, 785 km above the mouth of the Yellowstone River (Figure 1). Ecoregions within the Shields River drainage represent the Middle Rockies and Northwestern Great Plains provinces of the Temperate Steppe and Temperate Desert divisions (Woods et al. 1999; Appendix A). Stream flows during 2000 and 2001 were much lower than the 22-year average for the Shields River, especially from the end of June through September (Figure 2). While spring flows in 2002 were higher than average, base flows were lower than average (Figure 2).

Bangtail, Brackett, Canyon, Flathead, Willow, Potter, Cottonwood, Chicken, and Falls creeks and most of their tributaries were surveyed (Figure 1). More detailed descriptions of each stream are provided in the "Results" section. These streams supported YCT, brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), mountain whitefish (*Prosopium williamsoni*), white suckers (*Catostomus commersoni*), longnose suckers (*Catostomus catostomus*), mottled sculpin (*Cottus bairdi*), longnose dace (*Rhinichthys cataractae*) and lake chub (*Couesius plumbeus*). There are records of undesignated cutthroat trout (most likely these were YCT, but they could have been westslope cutthroat trout, *O. c. lewisi*), brook, rainbow, and brown trout having been stocked into these streams from 1932 to 1968 (Appendix B). Columbia spotted frogs (*Rana luteiventris*) and northern leopard frogs (*Rana pipiens*) have been recorded in the basin.

Methods

Sample Site Selection

A systematic sampling scheme was employed to estimate both the relative abundance and distribution of fishes and to quantify stream habitat characteristics. Sample sections ranging from 45 to 310 m were surveyed at a frequency of approximately every 0.8 km (0.5 mile) of

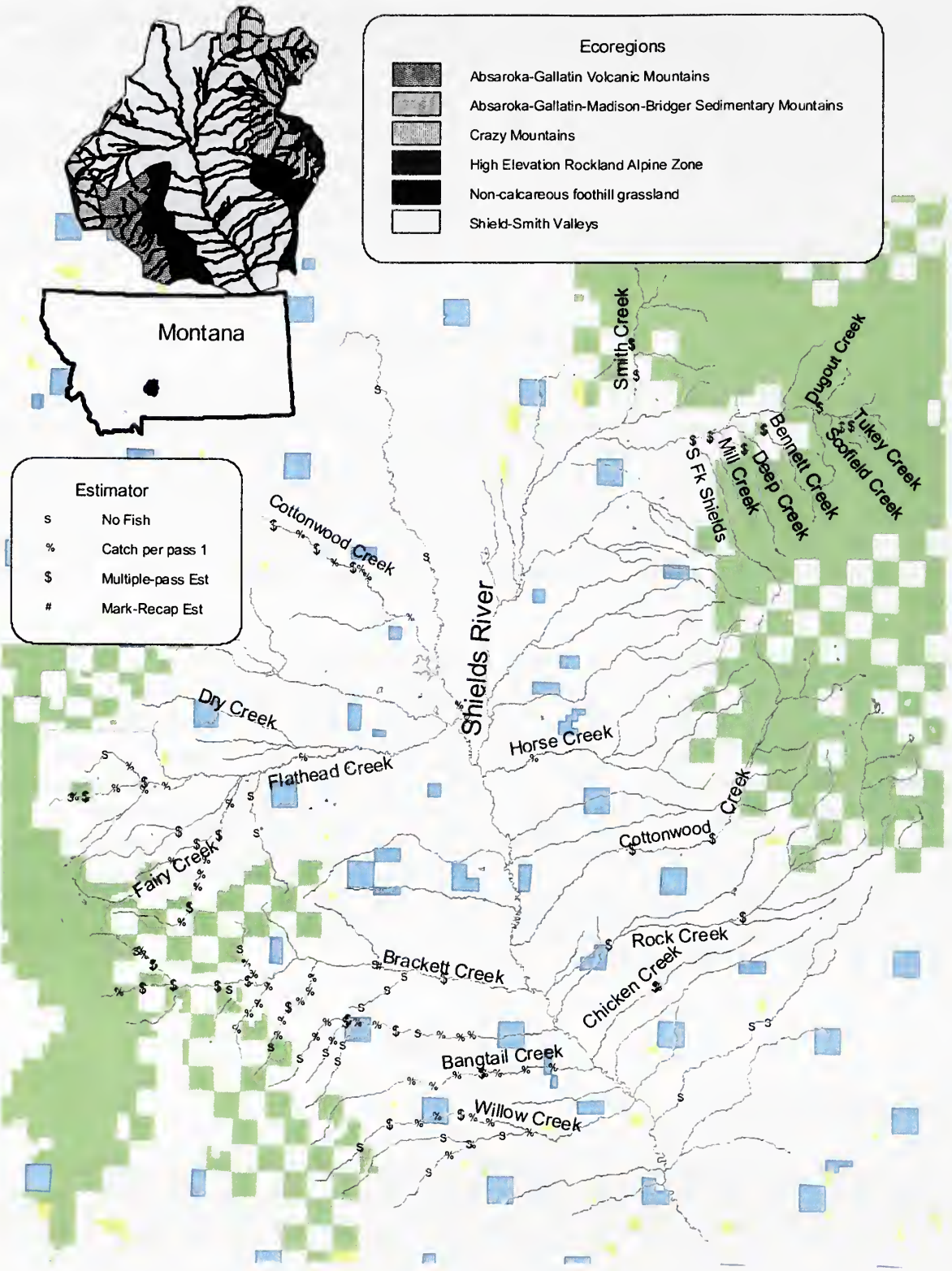

Figure 1. Map of the Shields River drainage showing level IV EPA ecoregions (top) and sites that were sampled in 2001 through 2003 to document fish distribution and abundance.

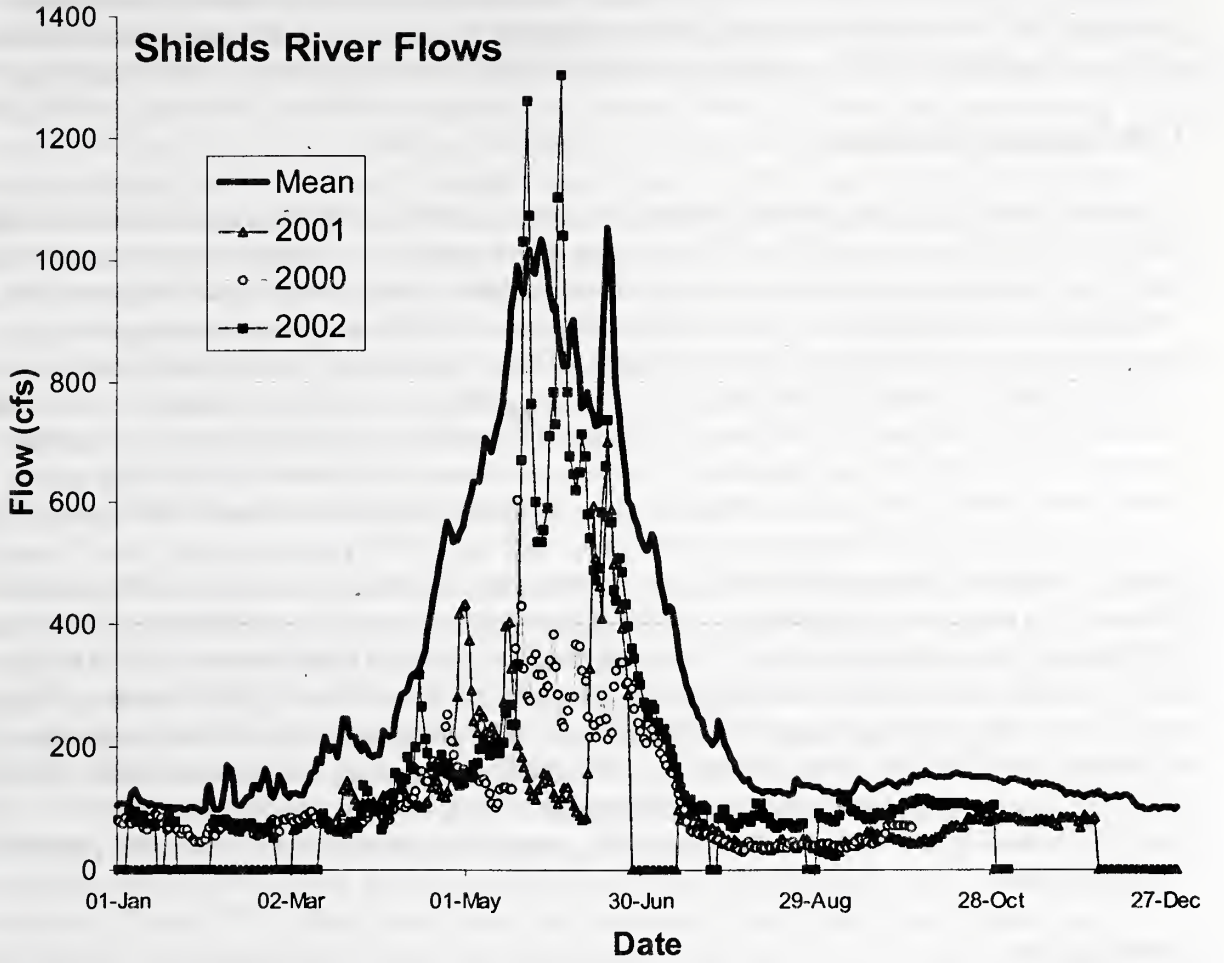

Figure 2. Daily flows in the Shields River above its mouth in 2000 (open circles and light gray line), 2001 (triangles and dark gray line), and 2002 (filled squares with thin line) along with the average daily flows from 1979 to 2001 (thick black line). Symbols on the x-axis indicate days the gauge was not working. Data is preliminary data from the USGS.

stream length by single-pass electrofishing with backpack Smith-Root electrofishers (Models SR-12BP, SR-15B). Sample section lengths were usually at least 20 times, with most at least 30 times, the average wetted stream width. Lyons (1992) found that when stream lengths of 35 times the mean wetted width were sampled with a towed electrofishing unit, all species of fish in fish communities in Wisconsin streams were generally captured. Sample sites were referenced by mile above the stream's mouth, and later converted to kilometers above the mouth, and by latitude and longitude obtained from a global positions system (GPS; Garmin 12XL®). All sample site locations are reported as stream kilometers (km) above the mouth from 1:100,000 scale hydrography. Field GPS locations were input into an ARCVIEW (Version 3.2; ESRI 1999; Environmental Systems Research Institute, Inc.) event theme and projected on 1:100,000 stream hydrography layers. The field GPS locations were corrected to overlay the hydrography layer

and stream km locations when discrepancies existed between field GPS and mapped locations (Figures 1). Scalar differences existed between stream km interpreted from 1:100,000 scale hydrography layers and true stream distances; however, data stored in the Montana fisheries database is georeferenced by stream km at the 1:100,000 scale, so this is the scale that was used.

Fish Population Estimates

At approximately 3.2 km (2 mile) intervals we conducted two- or three-pass depletion population estimates (VanDeventer and Platts 1985; Figure 1). Population estimates were not made when few or no fish were captured during the first electrofishing pass. Length (total length in mm) and weight (gm) were recorded for all captured salmonids. For two-pass estimates to provide reasonable results, we assumed that field calculated probabilities of capture (calculated as $1-(C_2/C_1)$; where C_1= number captured on the first pass, and C_2 = number captured on second pass) had to be 0.80 or higher (c.f., White et al. 1982; Riley and Fausch 1992). If field calculated probabilities of capture were less than 0.80 after two passes, additional electrofishing passes were usually made. Population estimates were calculated using a maximum likelihood estimator within the MICROFISH program (Van Deventer and Platts 1985) by species for fish 75 mm and longer. When no fish were captured on the second pass of a two-pass estimate, the population estimate was assumed to be the number of fish captured on the first pass and the SE was set at 0. Estimates of fish populations (fish 75 mm and longer) were also standardized per 100 m of stream length. Relative fish abundance was calculated as the number of fish 75 mm and longer per 100 m of stream length captured in the first electrofishing pass. Due to their large size, much of Brackett and Flathead creek could not be efficiently sampled using backpack electrofishers. We were able to sample several sections in Brackett Creek using a small boat to carry electrofishing gear and captured fish; however, we did not sample most of the lower portions of Flathead Creek.

Genetic Status

Fin samples from fish identified as YCT or possible hybrids were taken for genetic analysis. Where possible, a sub-sample of YCT captured at each sample site within a stream was represented in the genetic samples. The University of Montana Wild Salmon and Trout Genetics Laboratory, using Paired Interspersed Nuclear DNA Element-PCR (PINE) tests, will determine genetic status from these fin clips; however, results were not available at the time this report was completed. A listing of all tissue samples taken for genetic analyses and submitted to the Wild Salmon and Trout Genetics Laboratory are included in Appendix C.

Habitat Surveys

Site level habitat surveys were usually conducted at 3.2 km (2 mile) intervals in most sample sections where fish population estimates were made. The following data were collected for each macrohabitat type (pool, riffle or run) within a sample section: length; wetted and channel (width of normal bank-full channel) width, measured at a single location which represented an average width and depth of a habitat type; average depth, estimated by taking three depth measurements at equal distances across the single cross section where width was measured and dividing by 4; average maximum pool depth using 4 maximum (thalweg) depths were measured longitudinally

down the channel and averaged; residual pool depth and volume were estimated using the average maximum depth of the pool minus the maximum depth of the adjacent downstream habitat unit, along with surface area of the pool for volume (Lisle 1986, 1987). Over the entire sample section the following information was collected: surface area of suitable spawning habitat (defined as patches of substrate dominated by material 10 to 30 mm which cover at least 0.5 m^2); number of large (>15 cm in diameter) and small (≤ 15 cm in diameter) woody debris within the stream channel; number of large and small woody debris which span the stream channel; qualitative assessment of stream bank condition that ranked relative stability from low to high (and described the composition of the stream bank and the source of instability); qualitative assessment of instream cover which ranked the relative amount of instream cover from a low to high proportion of water volume with cover; qualitative assessment of bank overhead cover which ranked the amount of the water's surface which is covered or shaded; estimate of surficial streambed composition by size class in percentage by class; and a qualitative assessment of relative use of riparian areas by livestock or wildlife.

Change in Fish Communities Over Time

To assess whether nonnative brook trout were continuing to invade habitats occupied historically by YCT, sections that had been sampled by Berg (1975) in 1974 and had been documented to support brook trout or only YCT were re-sampled either as part of our systematic sampling or by explicitly re-sampling these sections. Since most of Berg's (1975) sample sites were located at road crossings, it was easy to re-locate these sample sites. In most cases Berg did not clearly identify whether sample sections were above or below these road crossings, so I sampled both above and below road crossings for almost all repeated sections; however, I segregated these estimates into above and below road estimates to compare potential influences of these road crossings on relative species abundance and species composition above and below these crossings. Berg (1975) usually only conducted a single electrofishing pass in these sample sections, so I compared the species composition on a catch per 100 m of stream length basis for all sections. Where Berg (1975) had made population estimates, I compared population estimates. I reported all population estimates we made in these sections from 2001 to 2003 to illustrate the relative capture efficiencies that were estimated in these sections. Thermographs were placed at most of these sample sites during 2003 from mid-June through the summer period.

Results

Antelope Creek Drainage

There are two streams named Antelope Creek in the Shields drainage. One enters the Shields River near river km 43.7, between Looking Glass and Flathead creeks on the west side of the valley, while the other enters the Shields River further upriver at river km 64.9, immediately below Cole Creek. The lower Antelope Creek between Looking Glass and Flathead creeks is the one detailed here. Antelope Creek is the only stream within this drainage. Antelope Creek is approximately 16.0 km in length and a cursory survey of the lower portion of the stream in 2002 found that flows were likely too low to support fish. It is possible that flows in the upper and middle portion of the stream may be sufficient to support fish.

Bangtail Creek Drainage

Bangtail Creek is the only named stream in the Bangtail Creek drainage. It flows into the Shields River near river kilometer 19.4 and drains approximately 3,500 ha. Its lower 7.7 km flows through the Shield-Smith Valleys level IV ecoregion, its middle 6.7 km flows through the Non-calcareous Foothill Grassland ecoregion, while its upper 6.6 km flows through the Absaroka-Gallatin Volcanic Mountains ecoregion (Figure 1; Woods et al. 1999; Appendix A).

Bangtail Creek

Bangtail Creek is approximately 21.0 km in length. Bangtail Creek has a moderately low gradient (2.5%) throughout its lower 17 km, where fish survey sections were located (Figure 3). A fish population estimate and habitat survey were conducted in Bangtail Creek just upstream from the Bangtail Road crossing, while single-pass electrofishing efforts were conducted at seven other sampling locations to document fish distributions and relative abundance (Figure 1). Willow and grasses dominated the riparian vegetation along the stream within private lands in the lower portion of this stream and some impacts from livestock grazing and trailing were observed. Forest Service personnel documented a single fish dispersal barrier consisting of a high gradient cascade located near km 18.2, though this may not be a total fish passage barrier. Average daily water temperatures in Bangtail Creek during the summer of 2000 near km 7.8 reached almost 19°C and were higher than 15°C for much of the summer, while maximum temperatures often exceeded 20°C (Figure 4). The entire length of the stream was not surveyed for fish barriers. Bangtail Creek was stocked from 1928 to 1968 with 15,720 brook trout and 39,000 brown trout fry (Appendix B).

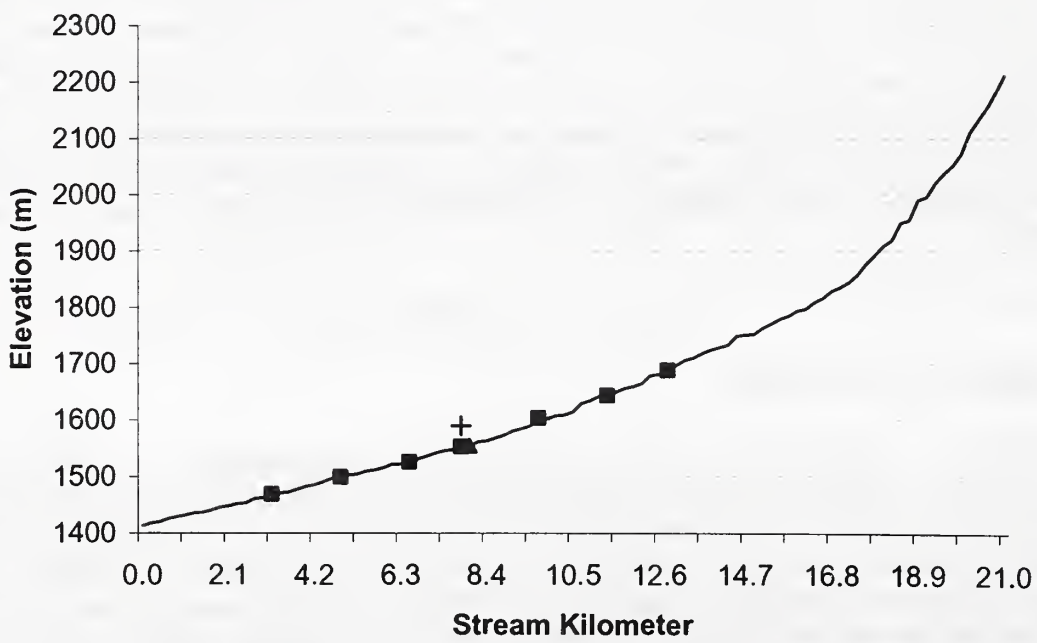

Figure 3. Elevational profile of Bangtail Creek channel showing 1-pass (solid squares) and depletion (triangle) fish sampling sections and thermograph location (+).

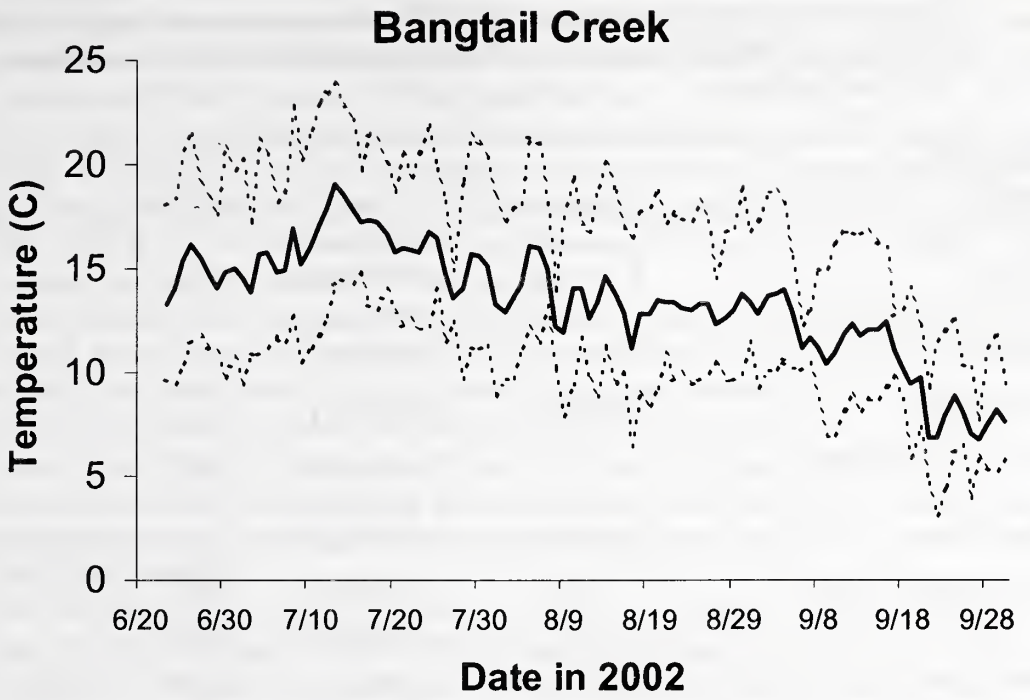

Figure 4. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in Bangtail Creek near stream km 7.8 during late-June through September 2002.

Bangtail Creek supported YCT, brook trout, and mottled sculpin. A genetic sample of 12 YCT taken in August of 1990 by the Gallatin National Forest near km 7.9 was analyzed by allozyme electrophoresis and no evidence of introgression was found in this sample (Appendix D). Genetic samples of 25 WCT were taken during 2001 from five different locations throughout Bangtail Creek (Appendix C). Analysis of 24 of these individuals indicated that YCT were slightly introgressed by rainbow trout; however, it was unclear how far up the stream this introgression extended (Table 1). Electrofishing catches indicated that the relative abundance of trout increased in an upstream direction (Figure 5). Only brook trout and sculpins were found below km 5.0, but YCT made up about 30% of the catch from km 6.4 to 7.9, 35% of the catch at km 9.7, and over 40% of the catch above km 10.0.

A 115 m sample section located at km 7.9 supported an estimated 8 YCT (SE: 0.4) and 23 brook trout (SE: 1.0) 75 mm, and longer (Table 2). Estimated densities (number/ha) of fish 75 mm and longer were similar to other larger tributaries to the Shields River (Figure 6). Estimated number of YCT and brook trout $\geq$ 150 mm were 14 and four, respectively (Appendix E). The eight YCT captured in this section averaged 151 mm (range: 104-218), while the 30 captured brook trout

Table 1. Genetic test results, based on PINES, for samples taken during 2001 and 2002 from Shields River drainage tributaries by stream name and date. Proportion of PINE fragments that were diagnostic of only Yellowstone cutthroat trout (% YCT), sample size (n), and introgressing species (RB = rainbow trout; WCT = westslope cutthroat trout) are provided.

DRAINAGE Stream	Kilometers	Date	% YCT	n	Species introgressing
BANGTAIL					
Bangtail	6.7 to 12.8	7/16 to 7/17/2001	97.6[1/]	24	RB
BRACKETT					
Brackett Creek	6.9 to 23.9	7/18 to 8/2/2001	-[2/]	20	RB
Horse Creek	0.8 to 1.6	6/27/2001	-[3/]	6	RB
M Fk Brackett Creek	1.9	7/19/2001	ND[4/]		
Miles Creek	2.2 to 5.8	6/25 to 6/26/2001	100	26	
N Fk Brackett Creek	1.0	7/31/2001	100[5/]	5	
	1.8	7/18/2002	ND[4/]		
Skunk Creek	0.4 to 3.9	6/27/2001	97.5[6/]	13	RB
Unnamed trib to Weasel Cr	0.1	6/27/2001	100[5/]	1	
CANYON					
Canyon	11.0 to 17.0	7/5 to 7/6/2001	99[7/]	23	WCT
Bridgman	0.2	7/6/2001	100[5/]	3	
Grouse	0.2 to 1.8	7/5/2001	100[5/]	6	
CHICKEN					
Chicken Creek	6.4	8/1/2002	ND		
FLATHEAD					
Flathead	13.6 to 25.8	8/27 to 8/29/2001	100[5/]	7	
Cache Creek	1.0 to 7.5	6/28/2001	97.3[8/]	22	RB
Carrol Creek	5.6	8/28/2001	100[5/]	2	
Fairy Creek	5.6 to 7.8	8/16 to 8/30/2001	100[9/]	10	
Frazier Creek	0.5	8/28/2001	100[5/]	2	
S Fk Flathead Creek	1.7 to 3.7	8/27/2001	95.5[10/]	14	WCT
POTTER					
Cottonwood Creek	10.9 to 17.6	7/15 to 7/29/2002	ND[4/]		
WILLOW					
N Fk Willow Creek	2.7 to 9.3	8/14 to 8/15/2001	100	19	
S Fk Willow Creek	12.4 to 14.0	8/13/2001	100[5/]	3	

Table 1. (Footnotes)

[1/] 21 of the 24 individuals displayed only PINE fragments diagnostic of YCT, while three individuals also displayed fragments diagnostic of rainbow trout that indicated they were post first generation hybrids between YCT and rainbow trout.

[2/] 19 of the 20 individuals displayed only PINE fragments diagnostic of YCT, while one individual was identified as a first generation hybrid between YCT and rainbow trout.

[3/] 5 of the 6 individuals displayed only PINE fragments diagnostic of YCT, while one individual was identified as a post first generation hybrid between YCT and rainbow trout.

[4/] ND indicates no data yet available for this sample.

[5/] With the extremely small sample size nothing definitive can be concluded by the results.

[6/] 10 of the 13 individuals displayed only PINE fragments diagnostic of YCT, while three individuals were identified as post first generation hybrids between YCT and rainbow trout.

[7/] 21 of the 23 individuals displayed only PINE fragments diagnostic of YCT, while two individuals were identified as hybrids between YCT and westslope cutthroat trout.

[8/] 20 of the 22 individuals displayed only PINE fragments diagnostic of YCT, while PINE fragments diagnostic of rainbow trout were only found in two individuals, one of which was a first generation hybrid.

[9/] With the small sample size of 10 the power of detecting hybridization is only 70%.

[10/] 9 of the 14 individuals displayed only PINE fragments diagnostic of YCT, while five individuals were identified as hybrids between YCT and westslope cutthroat trout.

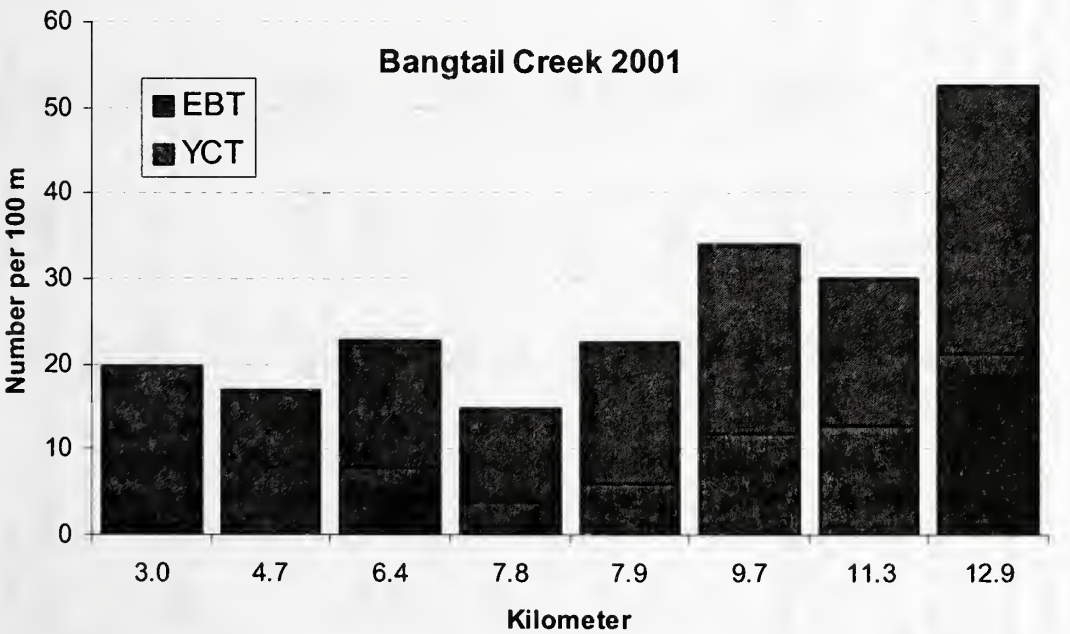

Figure 5. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) of Yellowstone cutthroat (YCT) and brook trout (EBT) captured in eight sections of Bangtail Creek during 2001 by stream kilometer.

Table 2. Stream, stream kilometer, date, length (m), width (m), number of electrofishing passes, species (Yellowstone cutthroat trout =YCT; brook trout = EBT; brown trout = BRT; rainbow trout = RB; mountain whitefish = MWF; longnose suckers =LNS; and white suckers = WSU) 75 mm and longer captured per electrofishing pass (Removal pattern with number of fish per pass separated by spaces), estimated number and standard error (SE), capture probability, standardized estimates as number per 100 m of stream length and number per hectare, and average length of captured fish in sample sections of Shields River tributaries sampled from 2001 through 2003.

STREAM		Section									
Km	Date	Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
BANGTAIL CR											
7.9	7/16/2001	115	2.6	2							
					EBT	19 4	23	0.85	169	20	769
							(1.0)		(77 - 239)	(0.8)	(32)
					YCT	7 1	8	0.89	151	7	268
							(0.4)		(104 - 218)	(0.3)	(13)
BENNETT CR											
1.1	6/23/2003	110	3.7	3							
					YCT	10 6 5	27	0.38	151	25	663
							(7.7)		(104 - 212)	(7.0)	(189)
1.2	6/23/2003	105	3.7	3							
					EBT	1 0 0	1	0.00	95	0.9	25.7
							(0.0)		(95 - 95)	(0.0)	(0)
					YCT	40 10 8	60	0.64	129	57	1544
							(2.4)		(88 - 264)	(2.3)	(62)
BRACKETT CR											
6.9	8/2/2001	300	3.0	3							
					RB	0 1 0	1	0.50	165	0.3	11
							(0.7)		(165. - 165)	(0.2)	(8)
					BRT	38 4 2	44	0.85	248	15	489
							(0.4)		(114. - 381)	(0.1)	(5)
					YCT	2 2 0	4	0.67	316	1	44
							(0.5)		(287. - 340)	(0.2)	(6)
					MWF	3 0 0	3			1	33
							(0.0)		(-)	(0.0)	(0)

Table 2. (Continued).

STREAM Km	Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
BRACKETT CR											
11.6	7/18/2001	310	4.0								
					004		184		221	59	1484
							(32.1)		(114 - 450)	(10.4)	(258.9)
					013		52		214	17	419
							(9.2)		(112 - 351)	(3.0)	(74.2)
					085		185		211	60	1492
							(16.4)		(76 - 401)	(5.3)	(132.3)
21.7	7/18/2001	300	4.5	2							
					EBT	4 0	4	0.00	0	1	30
							(0.0)		(0 - 0)	(0.0)	(0)
					BRT	65 6	71	0.92	158	24	526
							(0.8)		(96.5 - 424)	(0.3)	(6)
					YCT	46 3	49	0.94	163	16	363
							(0.5)		(83.8 - 317)	(0.2)	(3)
					MWF	24 4	28	0.88	225	9	207
							(0.9)		(137. - 330)	(0.3)	(6)
25.1	8/3/2001	300	3.0	3							
					EBT	4 0 0	4	0.00	0	1	44
							(0.0)		(0 - 0)	(0.0)	(0)
					BRT	30 9 2	41	0.76	199	14	456
							(0.9)		(106 - 370)	(0.3)	(10)
					YCT	10 3 1	14	0.74	199	5	156
							(0.6)		(99 - 297)	(0.2)	(7)
					MWF	14 3 2	19	0.73	219	6	211
							(0.8)		(171 - 305)	(0.3)	(9)

Table 2. (Continued).

STREAM Km	Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
CACHE CR											
1.0	8/16/2001	100	3.8	3							
					EBT	4 4 0	8	0.67	168	8	211
							(0.8)		(77 - 259)	(0.8)	(20)
					BRT	12 4 2	18	0.69	174	18	474
							(1.0)		(82 - 310)	(1.0)	(26)
					YCT	6 5 1	12	0.63	128	12	316
							(1.2)		(96 - 181)	(1.2)	(31)
6.3	6/28/2001	100	3.0	3							
					EBT	9 4 1	14	0.70	152	14	467
							(0.8)		(100 - 232)	(0.8)	(27)
					YCT	11 3 0	14	0.82	136	14	467
							(0.3)		(82 - 177)	(0.3)	(10)
CANYON CR											
11.0	7/6/2001	100	2.9	3							
					EBT	0 0 0	0	0.00	0	0	0
							(0.0)		(0 - 0)	(0.0)	(0)
					BRT	4 2 0	6	0.75	250	6	207
							(0.4)		(185 - 290)	(0.4)	(13)
					YCT	11 6 1	18	0.69	158	18	621
							(1.0)		(75 - 235)	(1.0)	(34)
14.3	7/5/2001	75	2.1	2							
					EBT	8 1	9	0.90	149	12	571
							(0.4)		(117 - 178)	(0.5)	(23)
					BRT	1 0	1	0.00	0	1	63
							(0.0)		(0 - 0)	(0.0)	(0)
					YCT	14 1	15	0.94	147	20	952
							(0.3)		(90 - 240)	(0.4)	(17)

Table 2. (Continued).

STREAM Km	Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
CARROL CR											
5.6	8/28/2001	100	2.0	3							
					EBT	31 11 3	46	0.69	164	46	2300
							(1.6)		(91 - 273)	(1.6)	(78)
					YCT	2 0 0	2	0.00	0	2	100
							(0.0)		(0 - 0)	(0.0)	(0)
CHICKEN CR											
6.3	8/14/2002	75	1.5	2							
					YCT	5 0	5	0.00	0	7	444
							(0.0)		(0 - 0)	(0.0)	(0)
COTTONWOOD CR (tributary to Potter Creek north of Wilsall, MT)											
11.7	7/11/2002	100	2.3	2							
					YCT	6 0	6	0.00	0	6	261
							(0.0)		(0 - 0)	(0.0)	(0)
14.4	7/15/2002	100	2.3	2							
					YCT	9 2	11	0.85	144	11	478
							(0.7)		(119 - 221)	(0.7)	(31)
17.6	7/11/2002	100	1.6	2							
					YCT	7 2	9	0.82	132	9	563
							(0.8)		(86 - 160)	(0.8)	(50)
COTTONWOOD CR (tributary to Shields entering from east at Clyde Park, MT)											
17.6	7/9/2003	300	7.2	3							
					EBT	6 3 4	18	0.33	129	6	83
							(8.6)		(94 - 200)	(2.9)	(40)
					YCT	12 5 2	19	0.68	131	6	88
							(1.1)		(76 - 290)	(0.4)	(5)
DEEP CR											
2.0	7/2/2003	150	4.3	3							
					EBT	20 9 2	32	0.66	154	21	496
							(1.6)		(80 - 200)	(1.1)	(25)
					YCT	3 1 0	4	0.80	148	3	62
							(0.2)		(116 - 182)	(0.1)	(3)

Table 2. (Continued).

STREAM Km Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
DUGOUT CR										
0.3 6/30/2003	150	2.9	2							
				YCT	9 1	10	0.91	147	7	230
						(0.3)		(85 - 236)	(0.2)	(8)
FAIRY CR										
5.6 8/30/2001	75	1.7	2							
				YCT	5 1	6	0.86	111	8	471
						(0.5)		(95 - 144)	(0.6)	(37)
FLATHEAD CR										
25.8 8/27/2001	100	2.8	2							
				EBT	26 2	28	0.93	143	28	1000
						(0.4)		(75 - 277)	(0.4)	(14)
				YCT	8 1	9	0.90	187	9	321
						(0.4)		(113 - 278)	(0.4)	(13)
GROUSE CR										
0.2 7/5/2001	75	2.0	2							
				EBT	3 2	5	0.71	156	7	333
						(1.2)		(125 - 195)	(1.6)	(80)
				YCT	9 1	10	0.91	111	13	667
						(0.3)		(76 - 180)	(0.5)	(23)
M FK BRACKETT										
0.1 7/31/2001	300	2.0	2							
				EBT	49 6	55	0.90	156	18	917
						(0.9)		(80 - 310)	(0.3)	(15)
				BRT	5 2	7	0.78	182	2	117
						(0.9)		(125 - 275)	(0.3)	(16)
				YCT	25 4	29	0.88	161	10	483
						(0.8)		(81 - 320)	(0.3)	(14)
				MWF	14 3	17	0.85	222	6	283
						(0.8)		(171 - 300)	(0.3)	(14)

Table 2. (Continued).

STREAM Km	Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
M FK BRACKETT											
1.9	7/19/2001	300	2.5	2							
					EBT	75 27	115	0.66	125	38	1533
							(8.0)		(80 - 246)	(2.7)	(106)
					YCT	11 5	17	0.70	142	6	227
							(2.5)		(100 - 222)	(0.8)	(33)
MILES CR											
3.9	6/25/2001	75	2.2	3							
					YCT	8 4 0	12	0.75	129	16	727
							(0.5)		(94 - 170)	(0.7)	(32)
MILL CR											
0.1	6/24/2003	100	1.8	3							
					EBT	8 4 0	12	0.75	144	12	667
							(0.5)		(103 - 193)	(0.5)	(30)
					YCT	11 1 0	12	0.92	131	12	667
							(0.1)		(88 - 248)	(0.1)	(4)
0.2	6/24/2003	100	1.8	3							
					EBT	2 2 0	4	0.67	141	4	222
							(0.5)		(90 - 190)	(0.5)	(30)
					YCT	5 1 0	6	0.86	157	6	333
							(0.1)		(122 - 265)	(0.1)	(8)
N FK BRACKETT CR											
1.8	7/18/2002	100	3.4	3							
					EBT	41 10 3	54	0.77	151	54	1588
							(1.0)		(90 - 268)	(1.0)	(28)
					YCT	2 2 0	4	0.67	194	4	118
							(0.5)		(113 - 282)	(0.5)	(16)

Table 2. (Continued).

STREAM Km	Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
N FK WILLOW CR											
4.5	8/14/2001	75	1.9	2							
					YCT	5 0	5	0.00	0	7	351
							(0.0)		(0 - 0)	(0.0)	(0)
9.3	8/14/2001	75	2.5	2							
					YCT	25 4	29	0.88	125	39	1547
							(0.8)		(79 - 264)	(1.1)	(45)
ROCK CR											
6.1	7/10/2003	205	4.2	2							
					BRT	27 7	35	0.79	206	17	407
							(1.9)		(111 - 400)	(0.9)	(22)
15.4	7/15/2003	103	9.5	3							
					EBT	5 4 1	10	0.63	138	10	102
							(1.1)		(91 - 209)	(1.1)	(11)
					BRT	4 1 2	7	0.58	206	7	72
							(1.2)		(92 - 377)	(1.2)	(12)
					YCT	4 0 0	0	0.00	0	0	0
							(0.0)		(0 - 0)	(0.0)	(0)
15.5	7/15/2003	105	9.5	2							
					EBT	11 2	13	0.87	154	12	130
							(0.6)		(98 - 245)	(0.6)	(6)
					BRT	4 1	5	0.83	179	5	50
							(0.5)		(94 - 318)	(0.5)	(5)
					YCT	1 1	0	0.00	0	0	0
							(0.0)		(0 - 0)	(0.0)	(0)
S FK FLATHEAD CR											
3.8	8/27/2001	100	1.7								
				2	YCT	8 1	9	0.90	92	9	529
							(0.4)		(75 - 135)	(0.4)	(21.7)

Table 2. (Continued).

STREAM Km	Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
S FORK SHIELDS											
0.1	7/8/2003	100	2.4	3							
					EBT	6 3 0	9 (0.5)	0.75	105 (75 - 175)	9 (0.5)	375 (19)
					YCT	2 0 1	3 (0.7)	0.60	119 (115 - 126)	3 (0.7)	125 (30)
0.2	7/8/2003	100	2.4	3							
					EBT	9 3 1	13 (0.7)	0.72	135 (85 - 204)	13 (0.7)	542 (28)
					BRT	2 0 0	0 (0.0)	0.00	0 (0 - 0)	0 (0.0)	0 (0)
					YCT	3 2 1	6 (1.0)	0.60	136 (110 - 165)	6 (1.0)	250 (42)
SCOFIELD CR											
0.7	6/25/2003	100	1.7	2							
					YCT	7 0	7 (0.0)	0.00	0 (0 - 0)	7 (0.0)	412 (0)
0.8	6/25/2003	100	1.7	4							
					YCT	4 5 4 1	17 (4.8)	0.33	111 (82 - 170)	17 (4.8)	1000 (282)
SMITH CR											
6.1	7/17/2003	200	5.2	3							
					EBT	14 5 2	21 (1.0)	0.70	172 (94 - 245)	11 (0.5)	202 (10)
					YCT	19 8 2	29 (1.1)	0.71	137 (76 - 250)	15 (0.6)	279 (11)

Table 2. (Continued).

STREAM Km	Date	Section Length	Width	Passes	Species	Removal pattern	Estimate (SE)	Capture probability	Average (range)	Estimate/100m (SE)	Estimate/Ha (SE)
SMITH CR											
8.2	6/26/2003	105	4.1	2							
					EBT	21 2	23 (0.5)	0.92	125 (76 - 212)	22 (0.4)	534 (10)
					YCT	5 1	6 (0.5)	0.86	130 (97 - 195)	6 (0.4)	139 (11)
8.3	6/26/2003	200	4.1	2							
					EBT	17 3	20 (0.8)	0.87	133 (83 - 237)	10 (0.4)	244 (9)
					YCT	3 1	4 (0.6)	0.80	129 (103 - 169)	2 (0.3)	49 (7)
TURKEY CR											
0.5	6/25/2003	100	1.7	2							
					YCT	7 0	7 (0.0)	0.00	0 (0 - 0)	7 (0.0)	412 (0)

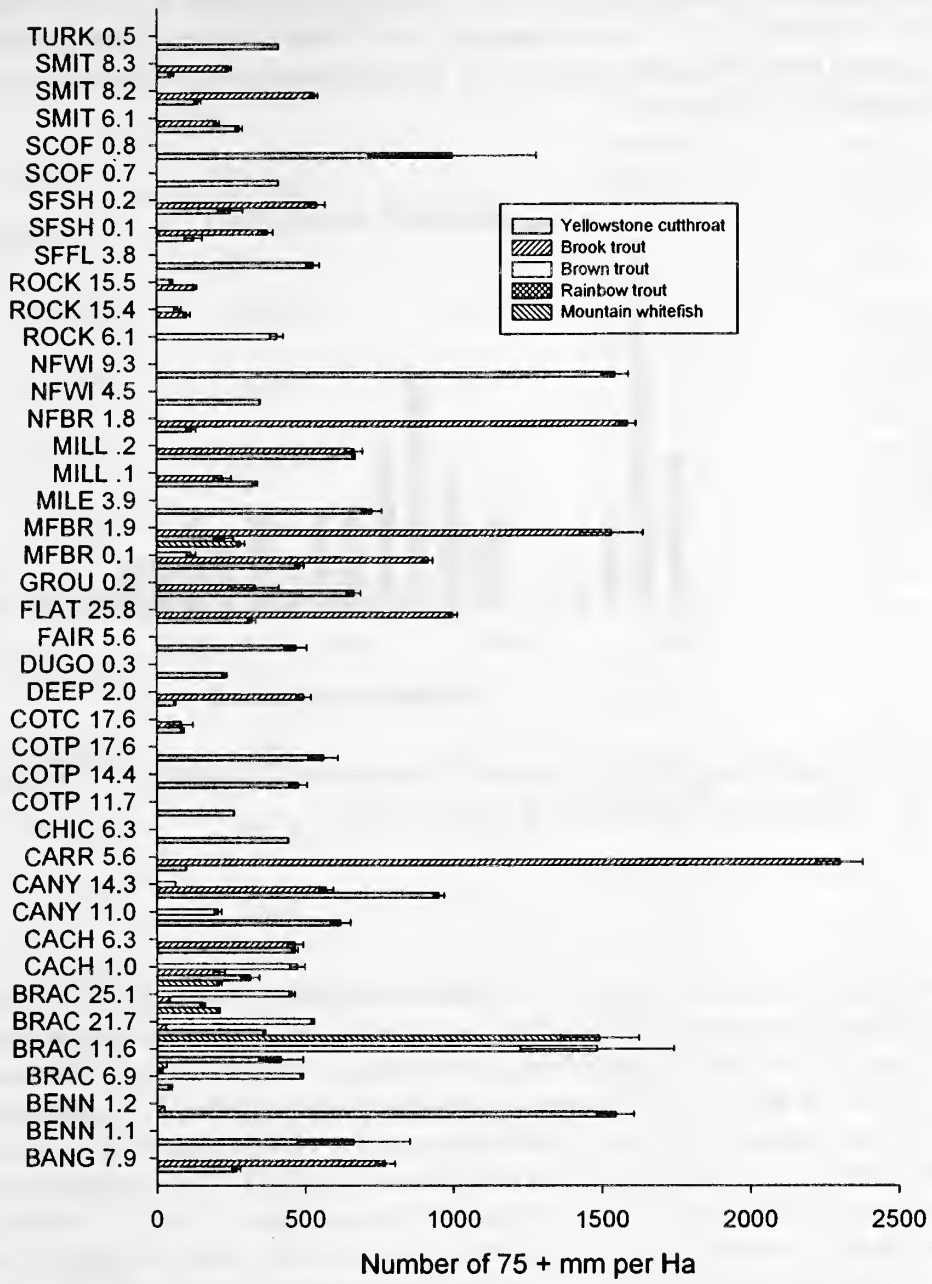

Figure 6. Estimated numbers of Yellowstone cutthroat trout, brook trout, brown trout, rainbow trout, and mountain whitefish per hectare of stream surface area in sections of Bangtail, Bennett, Brackett, Cache, Canyon, Carroll, Chicken, Cottonwood (Potter, COTP), Cottonwood (Clyde Park, COTC), Deep, Dugout, Fairy, Flathead, Grouse, Middle Fork Brackett (MFBR), Miles, Mill, North Fork Brackett (NFBR), North Fork Willow (NFWI), Rock, South Fork Flathead (SFFL), South Fork Shields River (SFSH), Scofield, Smith, and Turkey creeks by stream kilometer (shown after creek abbreviation) done from 2001 to 2003. Standard errors are shown as lines above the bars.

averaged 144 mm (range: 55-239; Table 3). Average lengths of YCT in all six sections where they were captured ranged from 134 to 215 mm, while average lengths of brook trout in the eight sections where they were captured ranged from 100 to 171 mm (Table 3). More smaller (< 100 mm), young brook trout than young YCT were captured, but the largest fish captured (> 240 mm) were YCT (Figure 7).

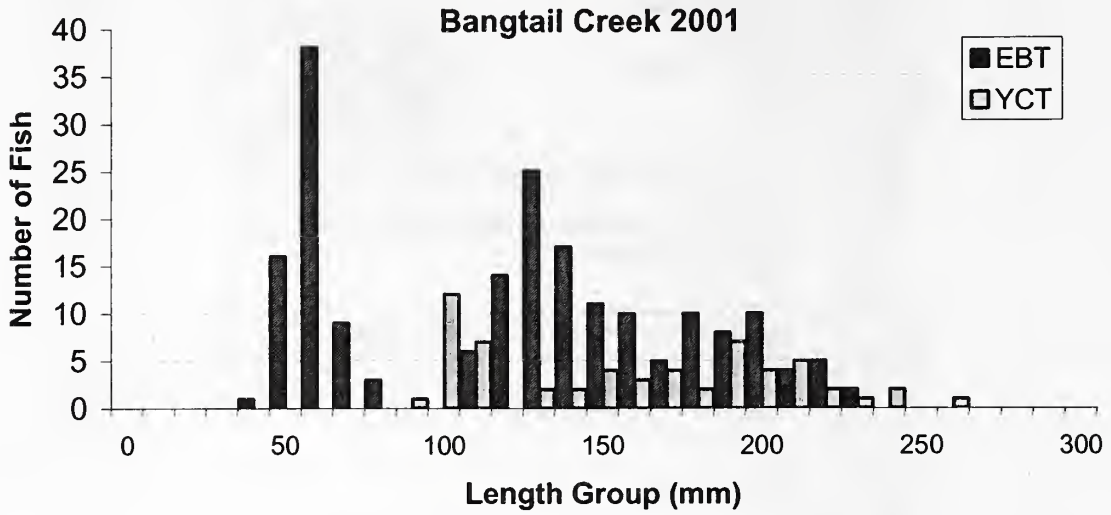

Figure 7. Length frequency histograms for Yellowstone cutthroat (YCT) and brook trout (EBT) captured in Bangtail Creek during 2001.

A habitat survey conducted at km 7.9 found that the streambed in Bangtail Creek at this location was comprised primarily of silt, cobble, and small gravel with sand and large gravel making up only about 25% of the streambed's surface (Table 4). Small woody debris was relatively abundant, while large woody debris was relatively scarce (Table 4). Little debris crossed the entire stream channel. Spawning habitat appeared to be moderately abundant, but the high levels of fine sediment may be limiting fish recruitment (Table 4). Pool habitats made up 41% by number and slightly over 31% by length of all habitat types (Table 5). Wetted width averaged 2.6 m and depth averaged 14 cm (Table 5). Pool volumes averaged about 2.7 m^3. Pools had an average maximum depth of 46 cm. Instream cover, bank cover, and pool quality were ranked moderately high, primarily due to small woody debris along and within the channel and presence of deep water in pools, while bank stability was ranked as moderate and riparian use was rated as high, due to livestock impacts along some of the stream channel (Table 6). While livestock impacts were observed, the relatively dense willow stands along the stream channel mitigated much of the impacts of livestock grazing. In addition, it must be noted that this sample section was near a fence and livestock impacts may have been higher here than at other sites along the stream.

Table 3. Average lengths and weights by species for fish captured in Shields River tributaries during from 2001 through 2003.

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
BANGTAIL CREEK					
BANGTAIL CR					
3.0	7/16/2001	EBT	31	100 (54- 200)	16 (2-65)
4.7	7/17/2001	EBT	24	116 (55- 218)	24 (1-89)
6.4	7/17/2001	EBT	11	171 (79- 237)	60 (5-132)
6.4	7/17/2001	YCT	6	215 (190- 241)	104 (70-142)
7.8	7/16/2001	EBT	10	162 (62- 211)	56 (3-96)
7.8	7/16/2001	YCT	3	134 (101- 162)	25 (9-37)
7.9	7/16/2001	EBT	30	144 (55- 239)	41 (3-137)
7.9	7/16/2001	YCT	8	151 (104- 218)	40 (11-107)
9.7	7/17/2001	EBT	43	115 (50- 227)	26 (2-119)
9.7	7/17/2001	YCT	12	183 (138- 212)	59 (23-85)
11.3	7/17/2001	EBT	17	139 (78- 210)	34 (6-92)
11.3	7/17/2001	YCT	13	165 (107- 268)	57 (11-174)
12.9	7/17/2001	EBT	28	140 (62- 230)	30 (2-102)
12.9	7/17/2001	YCT	17	141 (92- 241)	37 (8-134)
BENNETT CREEK					
BENNETT CR					
1.1	6/23/2003	EBT	1	95 (95- 95)	8 (8-8)
1.1	6/23/2003	YCT	23	143 (53- 212)	41 (1-106)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
1.1	6/23/2003	YCT	85	129 (42- 264)	30 (1-151)
1.2	6/23/2003	EBT	1	95 (95- 95)	8 (8-8)
1.2	6/23/2003	YCT	62	124 (42- 264)	26 (1-151)
BRACKETT CREEK					
BRACKETT CR					
6.9	8/2/2001	BRT	47	237 (71- 381)	187 (4-571)
6.9	8/2/2001	LNS	16	140 (93- 223)	45 (4-136)
6.9	8/2/2001	MWF	3	259 (93- 403)	233 (9-489)
6.9	8/2/2001	RB	1	165 (165- 165)	54 (54-54)
6.9	8/2/2001	YCT	4	316 (287- 340)	345 (281-426)
11.6	7/18/2001	BRT	126	221 (114- 449)	164 (22-975)
11.6	7/18/2001	MWF	172	206 (68- 401)	114 (31-553)
11.6	7/18/2001	WS	8	185 (104- 383)	125 (18-644)
11.6	7/18/2001	YCT	43	214 (111- 350)	128 (18-376)
21.7	7/18/2001	BRT	72	156 (40- 424)	67 (9-802)
21.7	7/18/2001	EBT	4	189 (134- 228)	71 (22-108)
21.7	7/18/2001	MWF	28	225 (137- 330)	124 (31-353)
21.7	7/18/2001	YCT	49	163 (83- 317)	59 (4-308)
25.1	8/3/2001	BRT	42	196 (56- 370)	85 (2-375)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
25.1	8/3/2001	EBT	7	109 (54- 194)	20 (1-65)
25.1	8/3/2001	MWF	19	219 (171- 305)	104 (44-254)
25.1	8/3/2001	YCT	14	199 (99- 297)	103 (8-247)
HORSE CR					
0.8	6/27/2001	YCT	4	122 (85- 185)	23 (5-58)
1.6	6/27/2001	YCT	3	152 (109- 191)	43 (14-68)
M FK BRACKETT CR					
0.1	7/31/2001	BRT	7	182 (125- 275)	76 (21-191)
0.1	7/31/2001	EBT	66	139 (50- 310)	38 (2-280)
0.1	7/31/2001	MWF	17	222 (171- 300)	109 (43-255)
0.1	7/31/2001	YCT	29	161 (81- 320)	68 (6-350)
1.9	7/19/2001	EBT	110	119 (32- 246)	29 (1-200)
1.9	7/19/2001	YCT	26	114 (65- 222)	27 (5-120)
4.5	7/23/2002	EBT	3	176 (156- 189)	71 (51-89)
MILES CR					
1.2	6/26/2001	YCT	3	165 (146- 182)	56 (37-73)
2.2	6/26/2001	YCT	10	147 (80- 201)	42 (6-93)
3.1	6/26/2001	YCT	8	126 (81- 185)	30 (8-81)
3.9	6/25/2001	YCT	12	129 (94- 170)	27 (7-63)
4.8	6/25/2001	YCT	5	107 (92- 146)	14 (7-32)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
5.8	6/26/2001	YCT	4	155 (128- 173)	46 (26-59)
N FK BRACKETT CR					
1.8	7/18/2002	EBT	54	151 (90- 268)	48 (7-221)
1.8	7/18/2002	YCT	5	169 (70- 282)	88 (4-213)
1.9	7/23/2002	EBT	25	137 (88- 205)	36 (8-103)
1.9	7/23/2002	YCT	3	84 (63- 120)	9 (2-22)
2.8	7/23/2002	EBT	9	170 (128- 194)	64 (25-103)
SKUNK CR					
0.4	6/27/2001	EBT	2	80 (30- 130)	30 (30-30)
0.4	6/27/2001	YCT	5	146 (78- 232)	38 (5-95)
1.6	6/27/2001	YCT	2	162 (150- 174)	51 (42-60)
2.5	6/27/2001	EBT	6	164 (35- 272)	93 (35-222)
2.5	6/27/2001	YCT	30	89 (68- 232)	12 (2-132)
3.9	6/27/2001	YCT	3	197 (182- 208)	- -
UNNAMED TRIB TO MILES CR					
0.4	6/26/2001	YCT	2	129 (123- 135)	33 (26-39)
UNNAMED TRIB TO WEASEL CR					
0.2	6/27/2001	EBT	1	130 (130- 130)	25 (25-25)
0.2	6/27/2001	YCT	1	112 (112- 112)	13 (13-13)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
CANYON CREEK					
BRIDGMAN CR					
0.1	7/6/2001	EBT	3	119 (115- 125)	18 (17-19)
0.1	7/6/2001	YCT	4	104 (56- 190)	22 (2-74)
CANYON CR					
6.0	7/6/2001	BRT	1	210 (210- 210)	67 (67-67)
6.4	7/6/2001	YCT	3	207 (154- 277)	118 (59-215)
8.1	7/6/2001	YCT	2	203 (200- 205)	54 (53-55)
11.0	7/6/2001	BRT	6	250 (185- 290)	154 (47-235)
11.0	7/6/2001	EBT	1	65 (65- 65)	2 (2-2)
11.0	7/6/2001	YCT	18	158 (75- 235)	44 (3-111)
12.5	7/6/2001	BRT	2	241 (142- 340)	27 (27-27)
12.5	7/6/2001	EBT	2	126 (115- 137)	22 (17-27)
12.5	7/6/2001	YCT	21	164 (96- 274)	53 (7-184)
14.3	7/5/2001	BRT	1	273 (273- 273)	191 (191-191)
14.3	7/5/2001	EBT	11	132 (55- 178)	31 (2-68)
14.3	7/5/2001	YCT	16	142 (60- 240)	38 (4-132)
15.8	7/5/2001	EBT	4	146 (49- 186)	46 (2-73)
15.8	7/5/2001	YCT	18	106 (76- 143)	13 (4-27)
17.0	7/5/2001	EBT	2	151 (129- 172)	42 (23-61)
17.0	7/5/2001	YCT	6	158 (120- 200)	47 (17-85)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
GROUSE CR					
0.2	7/5/2001	EBT	5	156 (125- 195)	- -
0.2	7/5/2001	YCT	14	95 (40- 180)	44 (44-44)
1.8	7/5/2001	YCT	1	220 (220- 220)	114 (114-114)
CHICKEN CREEK					
CHICKEN CR					
6.3	8/14/2002	YCT	5	124 (115- 137)	20 (14-29)
COTTONWOOD CREEK (near Clyde Park, MT)					
COTTONWOOD CR					
11.8	7/16/2003	BRT	3	389 (232- 555)	338 (151-525)
11.8	7/16/2003	YCT	6	98 (77- 140)	11 (4-30)
17.6	7/9/2003	BRT	1	328 (328- 328)	459 (459-459)
17.6	7/9/2003	EBT	13	129 (94- 200)	24 (8-83)
17.6	7/9/2003	YCT	21	125 (59- 290)	29 (1-257)
DEEP CREEK					
DEEP CR					
2.0	7/2/2003	EBT	31	154 (80- 200)	48 (5-88)
2.0	7/2/2003	YCT	4	148 (116- 182)	40 (17-65)
DUGOUT					
DUGOUT CR					
0.3	6/30/2003	YCT	10	147 (85- 236)	48 (6-148)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
FLATHEAD CREEK					
CACHE CR					
1.0	8/16/2001	BRT	30	131 (62- 310)	41 (2-281)
1.0	8/16/2001	EBT	10	148 (71- 259)	55 (4-177)
1.0	8/16/2001	YCT	12	128 (96- 181)	23 (10-57)
2.9	8/15/2001	BRT	12	119 (55- 327)	52 (2-396)
2.9	8/15/2001	EBT	13	135 (70- 220)	36 (3-108)
2.9	8/15/2001	YCT	4	179 (108- 266)	71 (11-175)
4.0	6/28/2001	EBT	3	125 (99- 150)	25 (11-44)
4.0	6/28/2001	YCT	3	191 (149- 249)	82 (43-150)
4.9	6/28/2001	EBT	7	160 (110- 250)	59 (14-165)
4.9	6/28/2001	YCT	10	137 (94- 257)	35 (8-175)
6.3	6/28/2001	EBT	14	152 (100- 232)	44 (10-135)
6.3	6/28/2001	YCT	18	120 (60- 177)	22 (2-58)
7.5	6/28/2001	EBT	8	121 (50- 192)	30 (2-96)
7.5	6/28/2001	YCT	2	110 (108- 112)	14 (13-14)
CARROL CR					
5.6	8/28/2001	EBT	48	158 (66- 273)	51 (2-223)
5.6	8/28/2001	YCT	2	175 (143- 206)	61 (29-93)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
FAIRY CR					
2.1	8/16/2001	BRT	7	188 (123- 286)	94 (24-240)
2.1	8/16/2001	EBT	7	152 (126- 198)	37 (19-83)
2.1	8/16/2001	YCT	1	128 (128- 128)	17 (17-17)
5.6	8/30/2001	YCT	13	75 (41- 144)	7 (1-29)
7.8	8/30/2001	EBT	6	118 (65- 195)	29 (2-75)
7.8	8/30/2001	YCT	7	140 (84- 266)	57 (7-240)
FLATHEAD CR					
13.6	8/30/2001	BRT	10	193 (86- 290)	- -
13.6	8/30/2001	LCH	3	82 (74- 90)	- -
13.6	8/30/2001	LNS	14	228 (108- 380)	- -
13.6	8/30/2001	MWF	1	350 (350- 350)	- -
13.6	8/30/2001	WS	8	152 (50- 450)	- -
13.6	8/30/2001	YCT	2	309 (297- 320)	- -
24.4	8/29/2001	EBT	18	179 (85- 260)	69 (6-204)
24.4	8/29/2001	YCT	16	188 (41- 296)	87 (1-247)
25.8	8/27/2001	EBT	31	136 (71- 277)	53 (3-229)
25.8	8/27/2001	YCT	15	133 (43- 278)	49 (1-236)
FRAZIER CR					
0.5	8/28/2001	EBT	2	105 (82- 127)	12 (5-18)
0.5	8/28/2001	YCT	2	120 (119- 120)	15 (13-17)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
S FK FLATHEAD CR					
1.8	8/27/2001	EBT	15	92 (61- 247)	19 (2-167)
1.8	8/27/2001	YCT	4	100 (75- 131)	15 (4-35)
3.8	8/27/2001	YCT	13	80 (34- 135)	8 (1-25)
4.7	8/29/2001	YCT	1	136 (136- 136)	30 (30-30)
MILL CREEK					
MILL CR					
0.1	6/24/2003	EBT	4	141 (90- 190)	42 (8-78)
0.1	6/24/2003	YCT	7	142 (55- 265)	46 (2-180)
0.2	6/24/2003	BRT	1	152 (152- 152)	36 (36-36)
0.2	6/24/2003	BRT	1	152 (152- 152)	36 (36-36)
0.2	6/24/2003	EBT	16	143 (90- 193)	43 (8-86)
0.2	6/24/2003	EBT	12	144 (103- 193)	43 (12-86)
0.2	6/24/2003	YCT	19	135 (55- 265)	35 (2-180)
0.2	6/24/2003	YCT	12	131 (88- 248)	28 (9-134)
POTTER CREEK					
COTTONWOOD CR					
11.3	7/15/2002	YCT	4	157 (113- 199)	49 (14-96)
11.7	7/11/2002	YCT	6	168 (120- 235)	60 (16-136)
13.1	7/10/2002	YCT	2	137 (136- 138)	27 (25-28)
14.4	7/15/2002	YCT	11	144 (119- 221)	36 (16-117)
16.0	7/10/2002	YCT	8	120 (91- 154)	20 (8-44)
17.7	7/11/2002	YCT	9	132 (86- 160)	32 (7-54)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
ROCK CREEK					
ROCK CR					
6.1	7/10/2003	BRT	34	206 (111- 400)	136 (14-675)
6.1	7/10/2003	YCT	1	157 (157- 157)	29 (29-29)
15.4	7/15/2003	BRT	12	195 (92- 377)	135 (8-486)
15.4	7/15/2003	BRT	7	206 (92- 377)	154 (8-486)
15.4	7/15/2003	EBT	24	143 (46- 245)	42 (1-140)
15.4	7/15/2003	EBT	10	138 (91- 209)	39 (9-116)
15.4	7/15/2003	YCT	5	167 (63- 377)	124 (2-436)
15.4	7/15/2003	YCT	7	161 (63- 377)	103 (2-436)
15.5	7/15/2003	BRT	5	179 (94- 318)	109 (9-392)
15.5	7/15/2003	EBT	14	147 (46- 245)	45 (1-140)
15.5	7/15/2003	YCT	2	147 (95- 199)	51 (9-92)
SCOFIELD CREEK					
SCOFIELD CR					
0.7	6/25/2003	YCT	7	123 (100- 191)	24 (10-78)
0.7	6/25/2003	YCT	21	115 (82- 191)	18 (6-78)
0.8	6/25/2003	YCT	14	111 (82- 170)	15 (6-40)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
SOUTH FORK SHIELDS RIVER					
S FORK SHIELDS					
0.1	7/8/2003	BRT	2	159 (155- 162)	48 (43-53)
0.1	7/8/2003	EBT	10	101 (70- 175)	15 (2-52)
0.1	7/8/2003	EBT	24	118 (69- 204)	24 (2-97)
0.1	7/8/2003	YCT	3	119 (115- 126)	16 (15-19)
0.1	7/8/2003	YCT	9	130 (110- 165)	25 (15-50)
0.2	7/8/2003	BRT	2	159 (155- 162)	48 (43-53)
0.2	7/8/2003	EBT	14	130 (69- 204)	30 (3-97)
0.2	7/8/2003	YCT	6	136 (110- 165)	29 (15-50)
SMITH CREEK					
SMITH CR					
6.1	7/17/2003	EBT	23	163 (56- 245)	61 (2-177)
6.1	7/17/2003	YCT	30	135 (66- 250)	36 (3-161)
8.2	6/26/2003	EBT	25	120 (66- 212)	29 (3-110)
8.2	6/26/2003	EBT	45	126 (66- 237)	33 (3-149)
8.2	6/26/2003	YCT	8	111 (54- 195)	21 (2-86)
8.2	6/26/2003	YCT	13	112 (54- 195)	21 (2-86)
8.3	6/26/2003	EBT	20	133 (83- 237)	38 (5-149)
8.3	6/26/2003	YCT	5	114 (57- 169)	20 (2-51)

Table 3. (Continued).

DRAINAGE STREAM Km	Date	Species[1/]	n	Average length (range)	Average weight (range)
TURKEY CREEK					
TURKEY CR					
0.5	6/25/2003	YCT	7	149 (126- 207)	37 (21-88)
0.5	6/25/2003	YCT	9	147 (126- 207)	36 (21-88)
0.6	6/25/2003	YCT	2	138 (135- 140)	30 (28-32)
WILLOW CREEK					
N FK WILLOW CR					
2.7	8/15/2001	YCT	6	155 (128- 191)	39 (20-69)
3.8	8/15/2001	YCT	2	189 (182- 195)	63 (57-68)
4.5	8/14/2001	YCT	6	153 (49- 264)	51 (1-160)
6.2	8/14/2001	YCT	3	157 (141- 176)	36 (23-54)
7.5	8/14/2001	YCT	15	145 (102- 194)	36 (10-87)
9.3	8/14/2001	YCT	33	115 (40- 264)	23 (1-219)
S FK WILLOW CR					
0.1	8/13/2001	YCT	2	204 (188- 220)	94 (69-118)
1.6	8/13/2001	YCT	1	152 (152- 152)	41 (41-41)
WILLOW CR					
8.4	8/15/2001	BRT	5	199 (180- 220)	80 (58-118)
8.4	8/15/2001	LNS	2	96 (68- 124)	12 (3-20)
8.4	8/15/2001	WS	4	253 (118- 305)	194 (15-277)

[1/] Species abbreviations are: EBT = brook trout; LCH = lake chub; BRT = brown trout; LNS = longnose sucker; RB = rainbow trout; WS = white sucker; and YCT = Yellowstone cutthroat trout.

Table 4. Streambed composition (% of each; boulder, cobble, large gravel, small gravel, sand and silt), frequency of small (< 150 mm) and large (≥ 150 mm) in-channel and cross-channel woody debris per km, and square meters of spawning habitat per km by stream, section, and date.

DRAINAGE / STREAM	Km	Date	Streambed composition (% by class)						Frequency (# km) of woody debris by size				Square meters of spawning habitat per km
									In-channel		Cross-channel		
			Boulder	Cobble	Lg Grav	Sm Grav	Sand	Silt	Small	Large	Small	Large	
BANGTAIL CREEK													
BANGTAIL CR													
	7.9	7/16/2001	5	20	10	20	15	30	287	61	9	0	60.9
BRACKETT CREEK													
M FK BRACKETT CR													
	1.9	7/19/2001	1	4	25	30	15	25	177	0	-[1/]	-[1/]	10.0
MILES CR													
	1.2	6/26/2001	5	30	15	20	5	25	132	26	0	13	144.7
	3.9	6/25/2001	3	40	22	15	5	15	467	40	13	0	18.7
N FK BRACKETT CR													
	1.8	7/18/2002	10	35	20	10	10	15	600	390	0	60	50.0
SKUNK CR													
	2.5	6/27/2001	5	25	30	25	5	10	200	60	0	10	190.0
CANYON CREEK													
CANYON CR													
	11.0	7/6/2001	10	25	25	20	5	15	210	130	0	10	110.0
	14.3	7/5/2001	10	35	30	10	5	10	200	13	0	13	40.0
CHICKEN CREEK													
CHICKEN CR													
	6.3	8/14/2002	5	5	10	30	20	30	960	640	133	160	213.3
FLATHEAD CREEK													
CACHE CR													
	1.0	8/16/2001	5	30	25	20	5	20	140	10	0	0	140.0
	6.3	6/28/2001	5	10	5	5	10	65	560	50	0	10	30.0
CARROL CR													
	5.6	8/28/2001	5	20	20	25	10	20	280	20	0	10	130.0

Table 4. (Continued).

DRAINAGE / STREAM		Streambed composition (% by class)						Frequency (# km) of woody debris by size				Square meters of spawning habitat per km
								In-channel		Cross-channel		
Km	Date	Boulder	Cobble	Lg Grav	Sm Grav	Sand	Silt	Small	Large	Small	Large	
FLATHEAD CR												
25.8	8/27/2001	15	25	25	15	5	15	180	40	0	0	100.0
S FK FLATHEAD CR												
3.8	8/27/2001	10	20	20	20	5	15	150	140	10	40	60.0
POTTER CREEK												
COTTONWOOD CR												
11.7	7/11/2002	5	50	5	5	20	15	40	30	10	10	50.0
14.4	7/15/2002	5	5	30	40	10	10	150	80	40	70	200.0
17.6	7/11/2002	50	20	10	10	5	5	30	50	0	20	50.0
WILLOW CREEK												
N FK WILLOW CR												
4.5	8/14/2001	2	10	15	20	15	35	400	147	0	13	14.7
9.3	8/14/2001	0	20	25	25	5	25	520	333	53	40	34.7

[1/] Forest Service sampling protocol did not assess number of cross-channel debris.

Table 5. Total length (m), average length (m), average width (m), average depth (cm), and average volume (cubic meters) of each habitat type and average thalweg depth (cm) and residual pool volume (cubic meters) by stream and section.

DRAINAGE / STREAM / Km / Date / Habitat type	n	Total length	Average length	Average width: Channel	Average width: Wetted	Average depth	Volume	Average thalweg depth	Residual pool volume
BANGTAIL CREEK									
BANGTAIL CR									
7.9 7/16/2001									
POOL	9	40.7	4.5	3.7	2.6	21	2.7	46	29
RIFFLE	9	63.5	7.1	3.8	2.7	8			
RUN	4	25.6	6.4	3.8	2.2	13			
For Entire Section	22	129.8	5.9	3.8	2.6	14			
BRACKETT CREEK									
M FK BRACKETT CR									
1.9 7/19/2001									
POOL	5	25.9	5.2	2.9	2.7	20	2.6	46	36
RIFFLE	5	65.0	13.0	2.6	2.4	10			
For Entire Section [1/]	10	90.9	9.1	2.8	2.5	15			
MILES CR									
1.2 6/26/2001									
POOL	4	11.6	2.9	2.2	1.8	21	1.1	44	26
RIFFLE	6	30.7	5.1	2.4	1.7	10			
RUN	6	36.1	6.0	2.2	1.6	16			
For Entire Section	16	78.4	4.9	2.3	1.7	15			
3.9 6/25/2001									
POOL	3	10.6	3.5	2.8	2.3	13	1.0	31	18
RIFFLE	4	47.1	11.8	2.8	2.3	10			
RUN	3	18.3	6.1	2.4	1.9	12			
For Entire Section	10	76.0	7.6	2.7	2.2	12			
N FK BRACKETT CR									
1.8 7/18/2002									
POOL	5	39.6	7.9	4.2	3.5	28	8.3	43	39
RIFFLE	7	52.0	7.4	4.8	3.7	11			
RUN	3	31.5	10.5	3.7	2.7	21			
For Entire Section	15	123.1	8.2	4.4	3.4	19			
SKUNK CR									
2.5 6/27/2001									
POOL	7	23.0	3.3	2.7	2.1	19	1.3	35	19
RIFFLE	7	69.2	9.9	3.0	2.4	8			
RUN	4	15.0	3.8	2.7	1.8	12			
For Entire Section	18	107.2	6.0	2.8	2.2	13			
CANYON CREEK									
CANYON CR									
11.0 7/6/2001									
POOL	5	26.8	5.4	4.2	3.2	33	5.6	62	34
RIFFLE	7	55.2	7.9	4.0	3.0	10			
RUN	3	18.5	6.2	3.0	1.9	17			
For Entire Section	15	100.5	6.7	3.9	2.9	19			

Table 5. (Continued).

Km	Date	Habitat type	n	Total length	Average length	Average width Channel	Average width Wetted	Average depth	Volume	Average thalweg depth	Residual pool volume
DRAINAGE											
STREAM											
14.3	7/5/2001										
		POOL	5	21.8	4.4	3.0	2.3	20	2.0	39	24
		RIFFLE	6	44.7	7.5	2.9	2.1	9			
		RUN	4	27.9	7.0	2.6	1.8	14			
		For Entire Section	15	94.4	6.3	2.9	2.1	14			
CHICKEN CREEK											
CHICKEN CR											
6.3	8/14/2002										
		POOL	4	10.8	2.7	4.4	2.1	17	0.9	24	25
		RIFFLE	6	57.3	9.6	3.8	1.4	2			
		RUN	3	10.4	3.5	3.0	1.2	6			
		For Entire Section	13	78.5	6.0	3.8	1.5	8			
FLATHEAD CREEK											
CACHE CR											
1.0	8/16/2001										
		POOL	3	19.1	6.4	4.4	3.5	22	4.8	49	27
		RIFFLE	7	49.0	7.0	5.5	4.1	7			
		RUN	3	20.1	6.7	4.8	3.5	13			
		For Entire Section	13	88.2	6.8	5.1	3.8	12			
6.3	6/28/2001										
		POOL	7	26.1	3.7	3.7	2.9	31	3.3	61	30
		RIFFLE	3	15.2	5.1	3.5	2.9	19			
		RUN	6	60.7	10.1	4.5	3.3	21			
		For Entire Section	16	102.0	6.4	4.0	3.0	25			
CARROL CR											
5.6	8/28/2001										
		POOL	5	22.8	4.6	2.6	2.2	20	2.0	43	22
		RIFFLE	5	33.3	6.7	3.2	2.0	9			
		RUN	5	34.0	6.8	2.3	1.7	13			
		For Entire Section	15	90.1	6.0	2.7	2.0	14			
FAIRY CR											
5.6	8/30/2001										
		POOL	7	14.5	2.1	2.5	1.9	12	0.5	24	10
		RIFFLE	3	24.8	8.3	3.1	1.6	8			
		RUN	5	29.4	5.9	2.7	1.5	10			
		For Entire Section	15	68.7	4.6	2.7	1.7	10			
FLATHEAD CR											
25.8	8/27/2001										
		POOL	4	19.0	4.8	3.6	2.8	21	2.7	46	28
		RIFFLE	7	41.0	5.9	3.8	2.4	8			
		RUN	4	26.7	6.7	5.6	3.5	14			
		For Entire Section	15	86.7	5.8	4.2	2.8	13			

Table 5. (Continued).

Km	Date	Habitat type	n	Total length	Average length	Average width Channel	Average width Wetted	Average depth	Volume	Average thalweg depth	Residual pool volume
DRAINAGE											
STREAM											
S FK FLATHEAD CR											
3.8	8/27/2001										
		POOL	6	11.8	2.0	3.3	2.0	12	0.4	23	13
		RIFFLE	11	57.8	5.3	3.2	1.6	5			
		RUN	1	3.0	3.0	3.1	1.1	5			
		For Entire Section	18	72.6	4.0	3.3	1.7	7			
POTTER CREEK											
COTTONWOOD CR											
11.7	7/11/2002										
		POOL	5	28.8	5.8	3.5	3.1	34	6.2	52	34
		RIFFLE	7	67.4	9.6	2.7	2.1	11			
		RUN	3	35.0	11.7	2.2	1.8	19			
		For Entire Section	15	131.2	8.7	2.9	2.3	20			
14.4	7/15/2002										
		POOL	4	20.0	5.0	2.9	2.5	31	3.8	37	39
		RIFFLE	9	109.0	12.1	3.8	2.4	7			
		RUN	4	19.7	4.9	3.2	1.9	15			
		For Entire Section	17	148.7	8.7	3.4	2.3	14			
17.6	7/11/2002										
		POOL	3	6.6	2.2	2.3	1.8	19	0.9	28	17
		RIFFLE	8	86.4	10.8	2.5	1.6	7			
		RUN	4	11.3	2.8	2.3	1.5	12			
		For Entire Section	15	104.3	7.0	2.4	1.6	11			
WILLOW CREEK											
N FK WILLOW CR											
4.5	8/14/2001										
		POOL	2	8.5	4.3	4.4	2.8	15	1.7	26	16
		RIFFLE	4	34.1	8.5	5.5	1.6	4			
		RUN	4	21.7	5.4	4.2	1.7	8			
		For Entire Section	10	64.3	6.4	4.7	1.9	8			
9.3	8/14/2001										
		POOL	7	20.6	2.9	4.8	2.9	14	1.1	30	20
		RIFFLE	8	36.0	4.5	4.8	2.4	5			
		RUN	3	16.8	5.6	4.8	2.0	9			
		For Entire Section	18	73.4	4.1	4.8	2.5	9			

[1/] Forest Service sampling protocol sub-sampled 10 habitat types of 36 observed habitat types within this 300 m long section.

Table 6. Rankings (0 = none or lowest; to 9 = highest) of instream cover, bank cover, bank stability, pool quality, and riparian use by stream, section, and date.

DRAINAGE STREAM Km	Date	Instream cover	Bank cover	Bank stability	Pool quality	Riparian use
BANGTAIL CREEK						
BANGTAIL CR						
7.9	7/16/2001	7	7	6	8	8
BRACKETT CREEK						
M FK BRACKETT CR						
1.9	7/19/2001	6	7	7	6	2
MILES CR						
1.2	6/26/2001	6	8	6	7	3
3.9	6/25/2001	4	5	7	5	3
N FK BRACKETT CR						
1.8	7/18/2002	8	6	7	8	2
SKUNK CR						
2.5	6/27/2001	7	8	9	8	1
CANYON CREEK						
CANYON CR						
11.0	7/6/2001	7	7	7	8	4
14.3	7/5/2001	6	6	6	7	3
CHICKEN CREEK						
CHICKEN CR						
6.3	8/14/2002	4	7	6	4	6
FLATHEAD CREEK						
CACHE CR						
1.0	8/16/2001	8	7	6	6	3
6.3	6/28/2001	7	7	6	8	5
CARROL CR						
5.6	8/28/2001	6	8	7	8	4
FLATHEAD CR						
25.8	8/27/2001	7	7	7	7	3
S FK FLATHEAD CR						
3.8	8/27/2001	7	7	6	7	4
POTTER CREEK						
COTTONWOOD CR						
11.7	7/11/2002	7	8	7	8	7
14.4	7/15/2002	8	9	8	8	7
17.6	7/11/2002	7	5	6	5	8

Table 6. (Continued).

DRAINAGE STREAM Km	Date	Instream cover	Bank cover	Bank stability	Pool quality	Riparian use
WILLOW CREEK						
N FK WILLOW CR						
4.5	8/14/2001	4	6	5	3	7
9.3	8/14/2001	7	7	4	7	6

Casual observation of the channel throughout the portion of Bangtail Creek below km 11 indicated that there was relatively high livestock use, but that willow stands along the stream moderated much of the impacts from this high livestock use. However, above km 11 little woody vegetation was present along the stream channel, most of the channel bottom was dominated by sedges and grasses, and livestock impacts were more severe. Observations of the habitat near km 3.2 indicated that the habitat was marginal for YCT and the channel was nearly dry in this portion of the stream. Limited groundwater re-charge of the channel maintained some flow at this location during sampling on July 16, 2001.

Brackett Creek Drainage

The Brackett Creek drainage is a relatively large, slightly less than 17,000 ha, drainage that has numerous named tributaries. Brackett Creek enters the Shields near river km 29.2, just below the town of Clyde Park, Montana (Figure 1). Three headwater forks, the South, Middle, and North, form Brackett Creek approximately 27 km above its mouth at the Shields River. The Middle Fork of Brackett Creek is designated as Brackett Creek on some maps and Middle Fork Brackett Creek on others. While I term this portion the Middle Fork of Brackett Creek, it is shown on 1:100,000 USGS maps as Brackett Creek and appears that way on NHD hydrography coverages used in GIS applications. Named tributaries, other than the three forks, that flow into Brackett Creek include Fox, Horse, Miles, Nixon, Sheep, Skunk, and Weasel creeks. The lower 11.3 km portion of Brackett Creek flows through the Shield-Smith Valleys level IV ecoregion, its next 4.5 km flows through the Non-calcareous Foothill Grassland ecoregion, its next 11.2 km flows through the Absaroka-Gallatin Volcanic Mountains ecoregion, while its upper 4.8 km flows through the Absaroka-Gallatin-Madison-Bridger Sedimentary Mountains ecoregion (Figure 1; Woods et al. 1999; Appendix A).

Brackett Creek

Brackett Creek is approximately 27 km in length (the Middle Fork adds another 4.8 km). It has a moderately low gradient (1-2%) in its lower 20 km where all 2001 fish survey sections were located (Figure 8). Fish population estimates were conducted in five sections of Brackett Creek, up and downstream from the Scott Ranch driveway crossing, downstream from the Hayhook Ranch driveway crossing, downstream from the bridge crossing on the driveway into the

Emanual property, and at the Harris property bridge (Figure 1). Willow and grasses dominated the riparian vegetation along the stream within private lands along most of this stream and some livestock impacts were observed. No fish dispersal barriers were documented; however, the entire length of the stream was not surveyed for fish barriers. Average daily water temperatures in the Middle Fork of Brackett Creek (just above the North Fork) were between 10 and 15°C, while average daily temperatures were much higher (15 to 20°C) in lower main Brackett Creek (Figure 9). Brackett Creek has a history of stocking with 58,340 brook, 248,000 brown, 79,200 undesignated (likely YCT) and 119,450 Yellowstone cutthroat, and 2,097 rainbow trout fry; 63,526 brook, 12,600 cutthroat, and 5,246 rainbow trout fingerlings; and 2,985 rainbow trout catchables released into its waters from 1928 to 1968 (Appendix B).

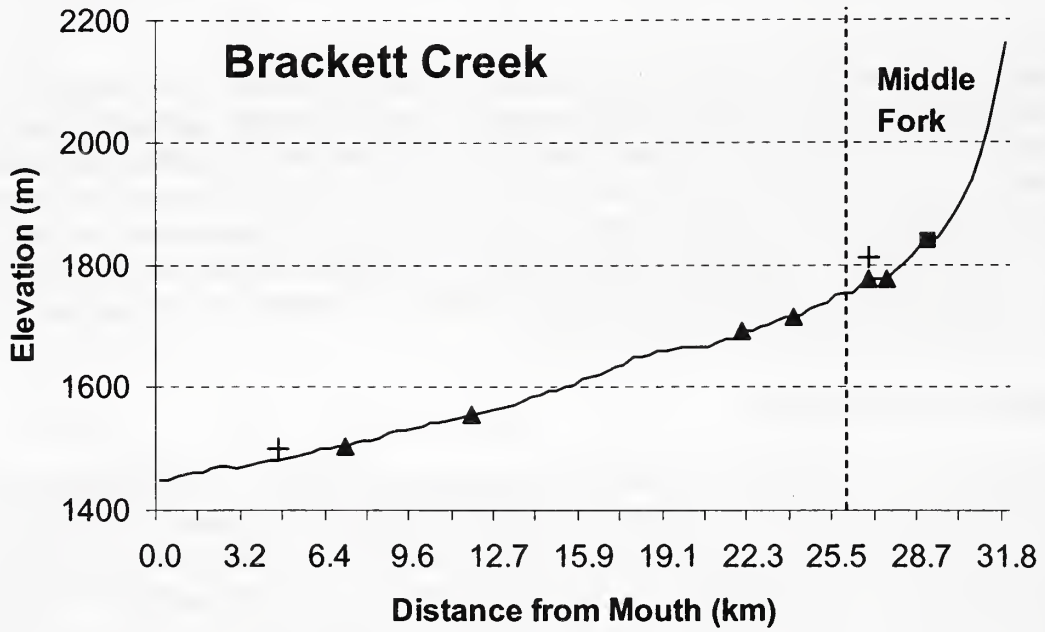

Figure 8. Elevational profile of Brackett Creek channel showing depletion and mark-recapture estimates (triangles) and 1-pass (solid square) fish sampling sections and locations of thermographs that recorded water temperatures during the summer of 2002 (+). The Middle Fork of Brackett Creek enters main Brackett Creek at km 26.1 and comprises the upper 5.8 km of this profile.

Brackett Creek supported YCT, brook, brown, and rainbow trout, mountain whitefish, longnose and white suckers, and mottled sculpin. A genetic sample of 20 YCT taken in June of 1987 by Chris Clancy of Montana FWP below the mouth of the North Fork (Figure 1) was analyzed by allozyme electrophoresis and no evidence of introgression was found in this sample (Appendix D). Genetic samples of 20 YCT were taken during 2001 from four different locations throughout Brackett Creek (Appendix C). Nineteen of these 20 samples displayed only PINE fragments diagnostic of YCT, while one individual was identified as a first generation hybrid between YCT and rainbow trout (Table 1). The single hybrid fish was captured immediately below the bridge at the Hayhook Ranch (km 11.6).

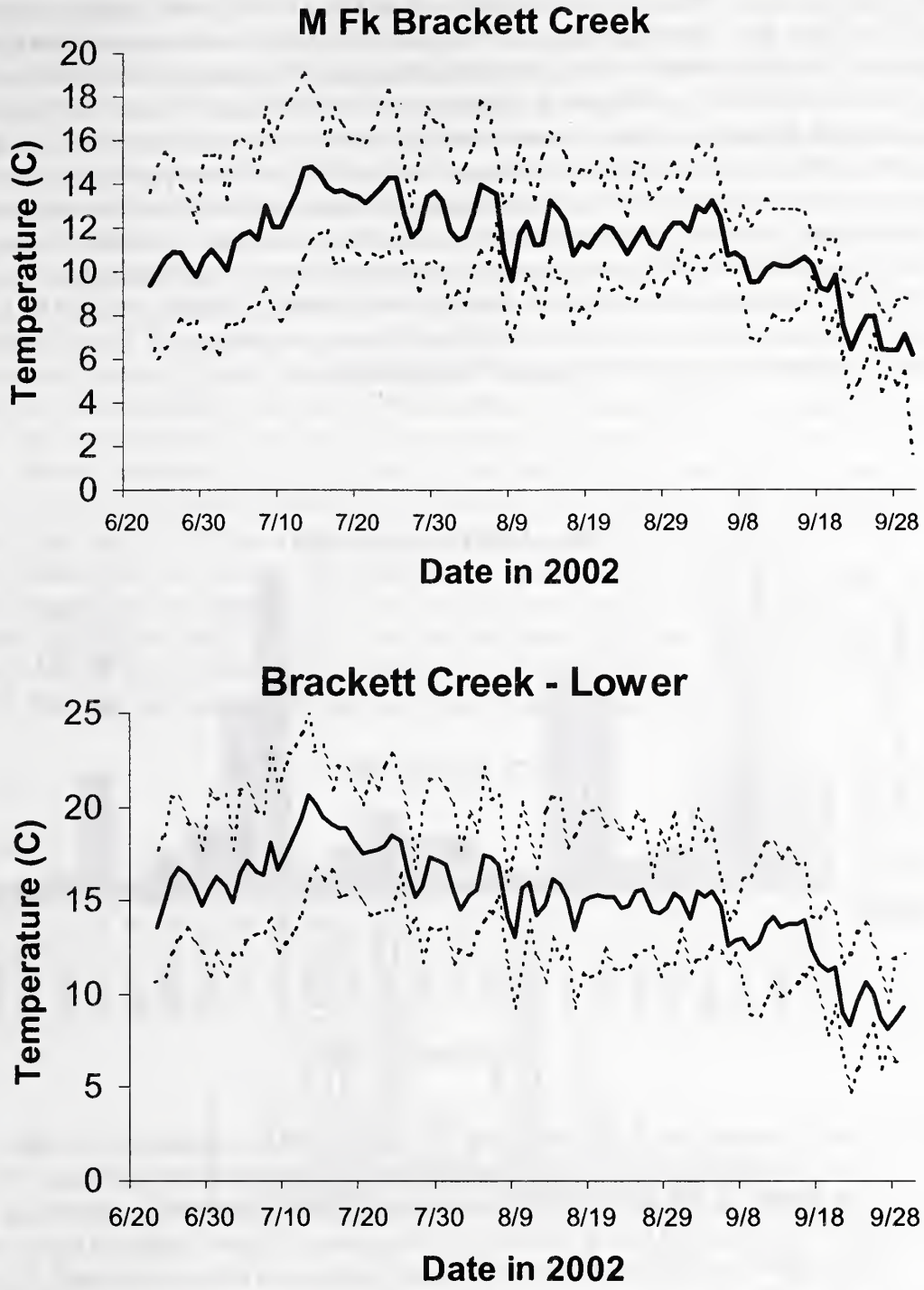

Figure 9. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in main Brackett Creek (lower) and the Middle Fork Brackett Creek (upper) during late-June through September 2002.

Electrofishing catches indicated that the relative abundance of trout was highest near kilometers 11 and 21 (Figure 10). The abundance of YCT was very low in the lower portion of the stream (below km 7), but they were relatively abundant from km 10 upstream to the mouth of the North Fork, making up 20 to 40% of the catch. Brown trout were abundant in most of the stream up to km 25, but their abundance dropped dramatically in the very upper portion of the creek. Brook trout were absent from Brackett Creek between km 6 and 12, but were present at relatively low abundance in the uppermost portion of the stream. Mountain whitefish were most abundant at km 11.6 and least abundant in the lowermost and uppermost sections. Numerous young-of-the-year (YOY) mountain whitefish were seen, but not netted, during sampling at km 11.6, while numerous YOY white suckers were seen, but not netted, during sampling at km 6.9. Suckers were moderately numerous up to km 11.6, but not noted above this point. Mottled sculpin were relatively abundant throughout the length of Brackett Creek.

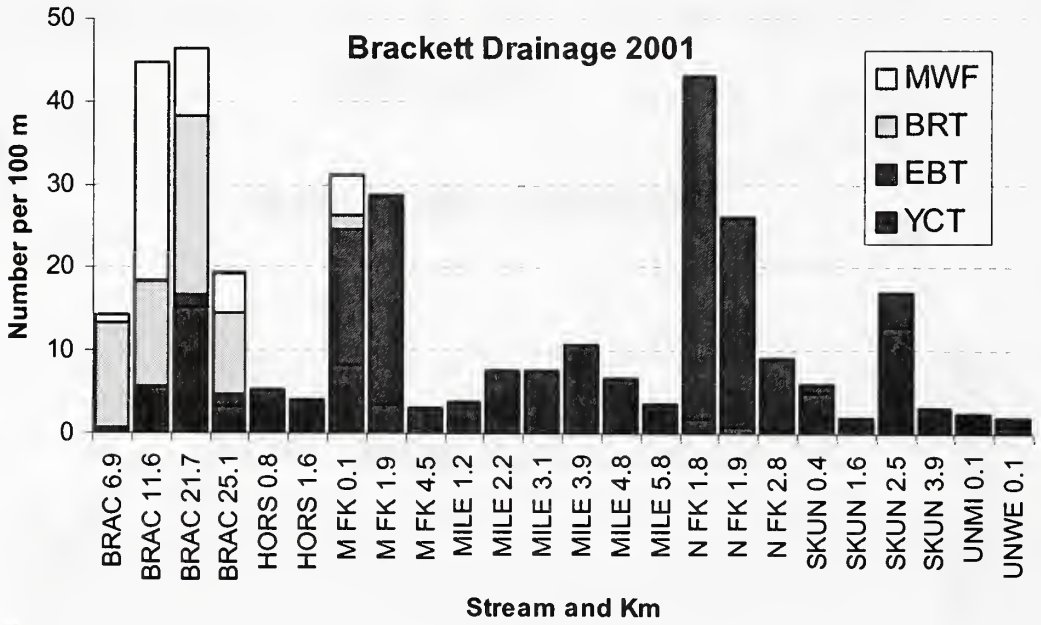

Figure 10. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) of Yellowstone cutthroat (YCT), brook trout (EBT), brown trout (BRT), and mountain whitefish (MWF) captured in four sections of Brackett Creek (BRAC), two sections of Horse Creek (HORS), one section of Middle Fork Brackett Creek (M FK), six sections in Miles Creek (MILE), one section of the North Fork Brackett Creek (N FK), four sections of Skunk Creek (SKUN), and one section each in an unnamed tributary to Miles Creek (UNMI) and an unnamed tributary to Weasel Creek (UNWE) during 2001 by stream kilometer.

The 300 m long lower sample section of Brackett Creek (Ford Ranch; km 6.9) supported an estimated 1 rainbow trout (SE: 0.7), 44 brown trout (SE: 0.4), 4 YCT (SE: 0.5), 16 white suckers (SE: 0.1), and 3 mountain whitefish 75 mm and longer (Table 2; Figure 6). The 310 m long sample section located below the Hayhook Ranch bridge (km 11.6) supported an estimated 184 brown trout (SE: 32.1), 52 YCT (SE: 9.2), and 185 mountain whitefish (SE: 16.4) that were 75 mm and longer. The estimate of mountain whitefish was uncertain due to an undetermined number of whitefish that suffered mortality during the marking run. This Hayhook Ranch section supported the highest estimated densities of brown trout compared to all other estimate sections sampled during the 2001 to 2003 period (Figure 6). The 300 m long Emanual sample section (km 21.7) supported an estimated 4 brook trout (SE: could not be estimated due to all fish captured on the first pass), 71 brown trout (SE: 0.8), 49 YCT (SE: 0.5), and 28 mountain whitefish (SE: 0.9) 75 mm and longer, while the 300 m long Harris sample section (km 25.1) supported an estimated 4 brook trout (SE: not estimated), 41 brown trout (SE: 0.9), 14 YCT (SE: 0.6), and 19 mountain whitefish (SE: 0.8). Lengths of captured brook trout generally averaged smaller than for other trout in sections where several trout species were captured (Table 3). The highest estimated densities of YCT occurred in the middle two sections (km 11.6 and 21.7), while the highest brown trout density occurred at km 11.6 (Figure 6). Mountain whitefish densities were very low in the lowest section, probably related to the relatively higher channel gradient observed in this section. Average lengths of captured YCT and brown trout were generally longer in lower sections than in upper sections, while those of whitefish were fairly consistent between sections (Table 3). Brown trout were larger than any other trout and length frequency histograms showed modes in length composition for brown trout, YCT and mountain whitefish that indicate several different age classes were present (Figure 11).

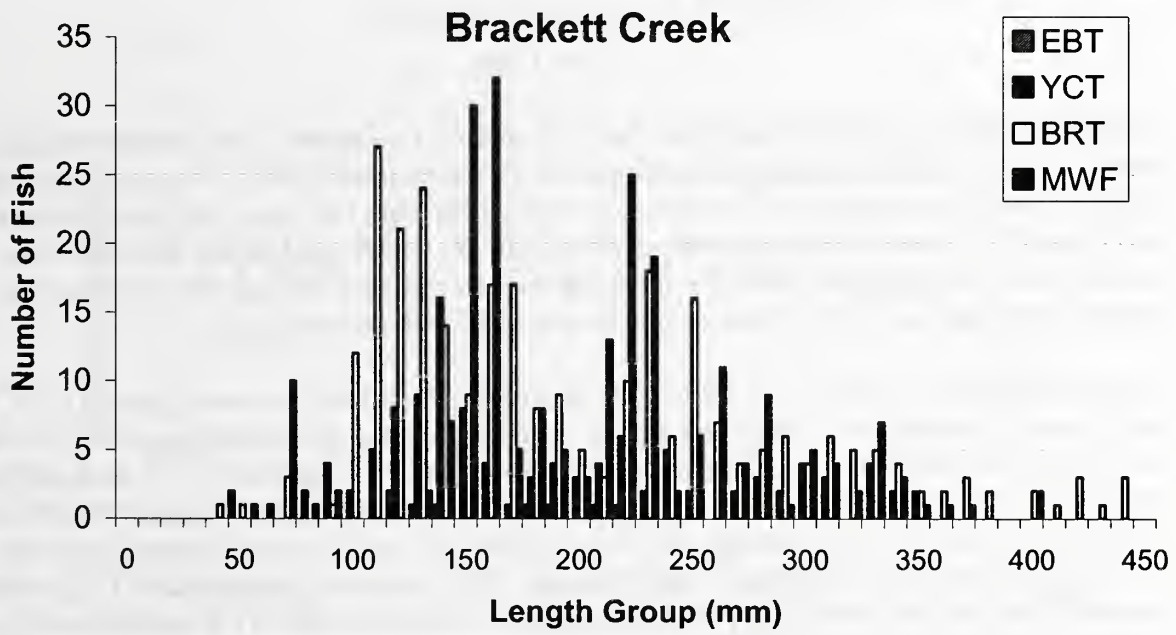

Figure 11. Length frequency histograms for brook (EBT), Yellowstone cutthroat (YCT), and brown trout (BRT) and mountain whitefish (MWF) captured in Brackett Creek during 2001 and 2002.

Habitat surveys were not conducted during 2001 in any of the Brackett Creek sections. Casual observations indicated that habitat in the lower estimate section, Scott Ranch driveway (km 6.9), contained some very deep, high quality pools and had several woody debris jams that provided complex cover. In addition, this section had little livestock use. The section below the Hayhook Ranch's bridge (km 11.6) had been recently rehabilitated with bank stabilization structures and constructed undercut banks, rock barbs, and constructed pools. This section had evidence of past livestock impacts, but was fenced to exclude livestock and the channel was in good condition. The Emanual population estimate section (km 21.7) had dense willow cover along the banks, little livestock use impacts, high quality pools, and some bedrock shelves in the channel. The Harris section (km 25.1) was similar to the Emanual section with dense willow stands along the channel, but did not have as many high quality pools. Beaver complexes were observed in many portions of Brackett Creek, especially near the mouth of Skunk Creek, but none of these areas were sampled.

Fox Creek

Fox Creek enters Brackett Creek at about km 11.9 from the north. Fox Creek is about 6.2 km in length. Fox Creek was surveyed on July 10, 2002 above its mouth, immediately above where it was diverted into a ditch; however, flows were so low this stream was found to be unable to support fish. In addition, a few areas of Fox Creek above this location were visually surveyed and these areas were also found to be too small to support fish. No records of any stocking into Fox Creek were found (Appendix B).

Horse Creek

Horse Creek enters Brackett Creek from the north at km 21.0. Horse Creek is about 4.8 km in length. It has a moderately high gradient (almost 5%) in its lower 3.4 km where all three 2001 fish survey sections were located, increasing to over 19% from km 3.4 to its headwaters at km 4.8 (Figure 12). Horse Creek is a relatively small stream with wetted widths less than 2 m. Average daily water temperatures remained between 10 and 14°C during 2002 (Figure 13). There were no records of any fish stocking into Horse Creek (Appendix B).

Single electrofishing passes were made in three separate 75 m long sections (Figure 1). YCT was the only fish species captured and no fish were found in the uppermost sample section at km 2.6. Genetic sampling of 9 fish from main Horse Creek in 1993 found that YCT were slightly introgressed (about 7%) with rainbow trout. Fin clip samples were taken from seven fish from two locations in Horse Creek during 2001 to again test for possible introgression (Appendix C). Five of the six individuals analyzed displayed only PINE fragments diagnostic of YCT, while one individual was identified as a post first generation hybrid between YCT and rainbow trout (Table 1). It appears that this YCT population is slightly introgressed with rainbow trout. Relative abundances of YCT were low at 5.3 and 4.0 per 100 m of stream length in the lower two sections (Figure 10). Captured YCT ranged from 85 to 191 mm and averaged 122 mm in the lower section and 152 mm in the middle section (Table 3). Numerous leopard frogs were observed throughout Horse Creek. No habitat surveys were conducted in Horse Creek. Several

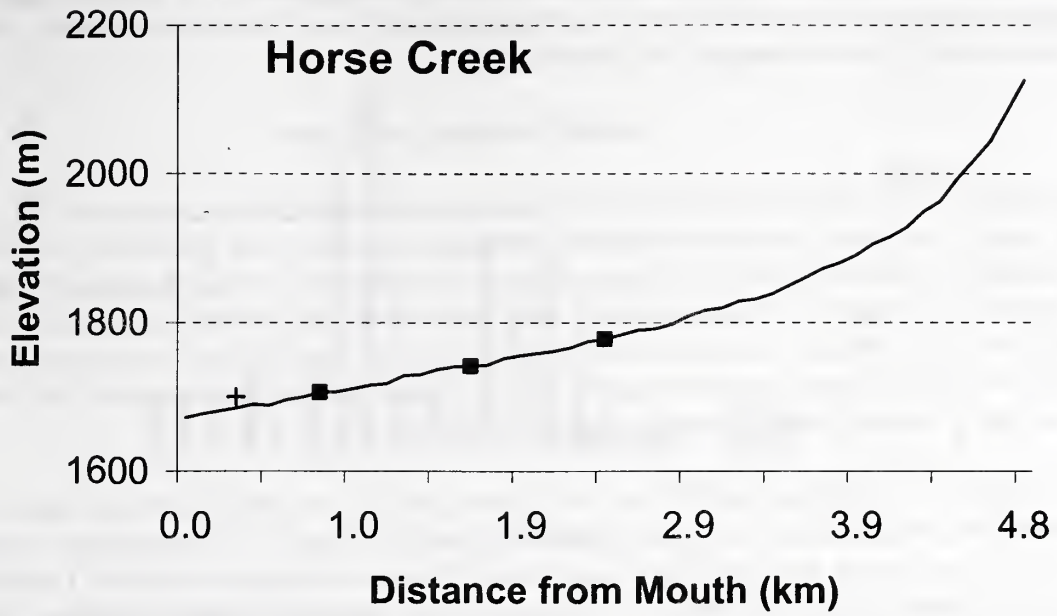

Figure 12. Elevational profile of Horse Creek channel showing 1-pass (solid squares) fish sampling sections and location of a thermograph that recorded water temperatures during the summer of 2002 (+).

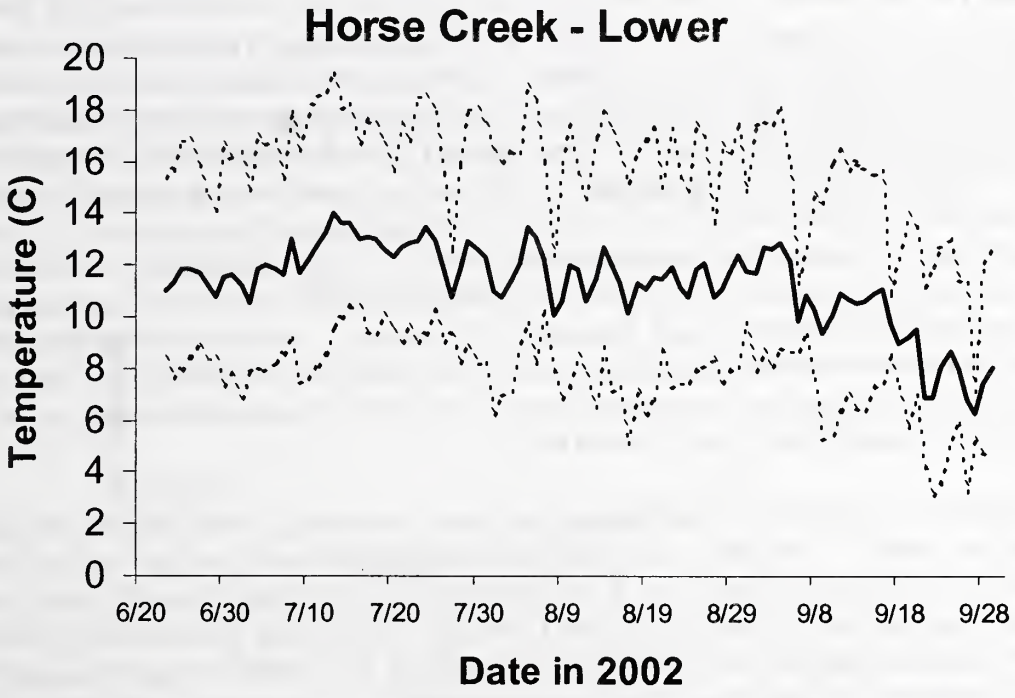

Figure 13. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in lower Horse Creek near km 0.3 during late-June through September 2002.

groundwater springs and seeps entered the stream channel near km 1.6. Some impacts to the stream channel from livestock were observed along the lower 1.6 km of the stream. Stream flow was deemed too low to support fish above km 2.0.

Middle Fork Brackett Creek

The Middle Fork enters Brackett Creek at its headwaters (km 26) from the west. It is about 4.8 km long. The lower 2 km of the Middle Fork has a moderately low gradient of 2 to 3%, while the upper 3.8 km has a relatively high gradient of 9% (shown as upper Brackett Creek from km 27 upstream; Figure 8). Water temperatures in the lower Middle Fork were relatively cool (Figure 9, top). While no records of any stocking into the Middle Fork were found, it is likely that some of the fish stocked into main Brackett Creek may have been released into the Middle Fork, due to naming conventions mentioned above.

The lowest section of the Middle Fork of Brackett Creek, just above the North Fork, supported brown trout, brook trout, YCT, and mountain whitefish (Figure 10). The middle section support only YCT and brook trout, while the upper section supported only brook trout. Genetic testing of 21 fish from the Middle Fork in 1987 using allozyme analysis found no evidence of introgression (Appendix D). Fin clips from five fish from the upper Middle Fork and five fish from the lower Middle Fork (designated as the North Fork in the analyses in Table 1; see below) were taken in 2001 to test for introgression (Appendix C). The 5 fish from the upper Middle Fork have not yet been analyzed (Table 1). A 300 m sample section located immediately above the North Fork supported an estimated 55 brook trout (SE: 0.9), 7 brown trout (SE: 0.9), 29 YCT (SE: 0.8), and 17 mountain whitefish (SE: 0.8) 75 mm and longer (Table 2; Figure 6 and Appendix E). A two-pass removal estimate was conducted by Forest Service personnel in a 300 m long sample section of the Middle Fork about 1.9 km above its junction with the North Fork. This section supported an estimated 115 brook trout (SE: 8.0) and 17 YCT (SE: 2.5) 75 mm and longer (Table 2; Figure 6; and Appendix E). Densities of brook trout were relatively high, while YCT densities were low to moderate (Figure 6). Captured brook trout averaged 119 mm and YCT averaged 114 mm in this sample section (Table 3). There appeared to be a relatively strong age-1 year-class of brook trout (lengths of 80 to 120 mm), while no obvious age groups of YCT could be interpreted from the length frequencies (Figure 14). All the mountain whitefish captured in the lower Middle Fork were over 170 mm, indicating whitefish reproduction may not be occurring this high in the basin and that age-1 and older whitefish are moving up to this portion of the creek (Table 3 and Figure 14).

A habitat survey was conducted using methodologies developed by the Gallatin National Forest. The sample section 1.9 km above the mouth had a streambed dominated by smaller size particles, no large woody debris, low to moderate frequencies of small woody debris, and relatively low amounts of spawning habitat (Table 4). This section had an average wetted width of 2.5 m and an average depth of about 15 cm (Table 5). Pool habitats made up about half the section by number, but less than a third by length (Table 5). Pools were of relatively high quality with good volumes and depths and abundant cover (Tables 5 and 6). Streambanks were relatively stable and had a moderately high proportion of undercuts (Table 6). Instream and bank cover were both rated as moderately high (Table 6).

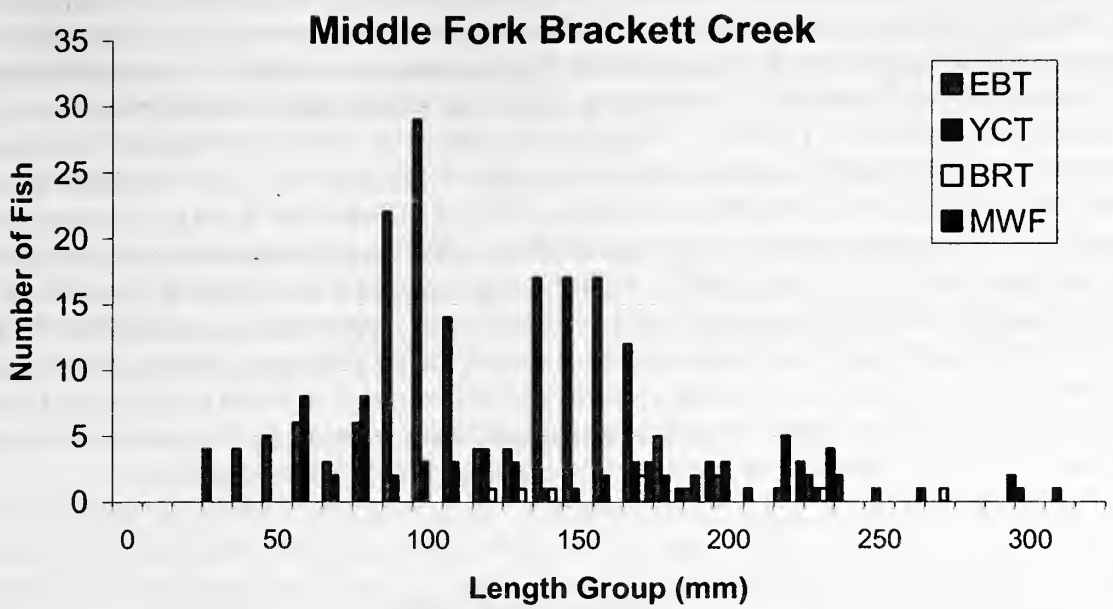

Figure 14. Length frequency histograms for brook (EBT), Yellowstone cutthroat (YCT), and brown trout (BRT) and mountain whitefish (MWF) captured in the Middle Fork of Brackett Creek during 2001.

Miles Creek

Miles Creek enters Brackett Creek at km 15.8 from the south. Miles Creek is 8.8 km in length. It has a moderately low gradient (3%) in its lower 6.0 km where five 1-pass electrofishing sections and one population estimate section were sampled during 2001, increasing to over 11% from km 6.0 up to its headwaters at km 8.8 (Figure 15). Two small, unnamed tributaries enter Miles Creek. No records of any stocking into Miles Creek were found (Appendix B).

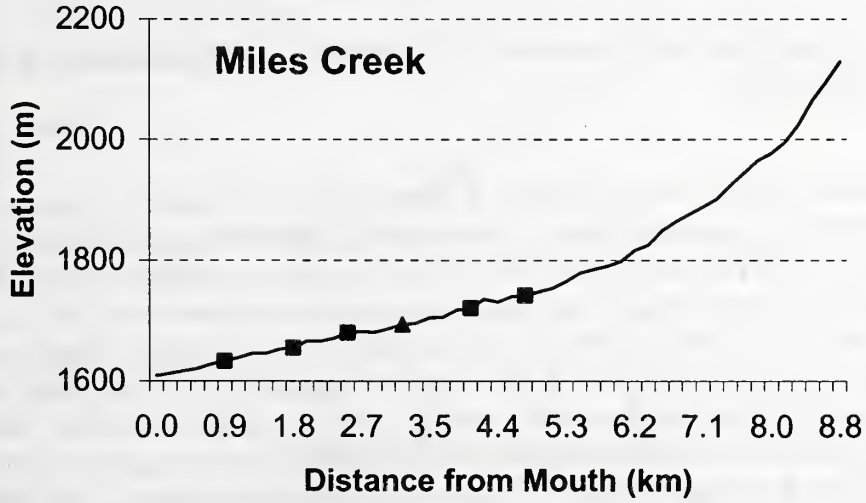

Figure 15. Elevational profile of Miles Creek channel showing 1-pass (solid squares) and depletion (triangle) fish sampling sections.

YCT and mottled sculpin were the only fish species captured in Miles Creek. No previous genetic testing of fish from Miles Creek has been reported (Appendix D). Fin clips from 29 fish from six different locations throughout Miles Creek were taken in 2001 to test for introgression in this population (Appendix C) and testing of 26 of these fish found no evidence of introgression in the YCT (Table 1). Relative abundances of YCT were relatively low throughout the stream with the highest relative abundance at km 3.9 (Figure 10). Two unnamed tributaries enter Miles Creek near its headwaters, one near km 6.4 and one near km 6.6. The one entering near km 6.4 supported very low numbers of fish (two YCT captured in 84 m), while the one entering near km 6.6 was dry in 2001. No fish were captured in Miles Creek above km 6.4. In a 75 m long sample section located at km 3.9, Miles Creek support an estimated 12 YCT (SE: 0.5) 75 mm and longer, a relatively high estimated density of YCT compared to other 2001 sample sections (Table 2; Figure 6). Average lengths of YCT captured in Miles Creek ranged from 107 to 165 mm with fish of larger average size caught in the lowermost and uppermost sections (Table 3). No YCT larger than 220 mm were captured (Table 3 and Figure 16).

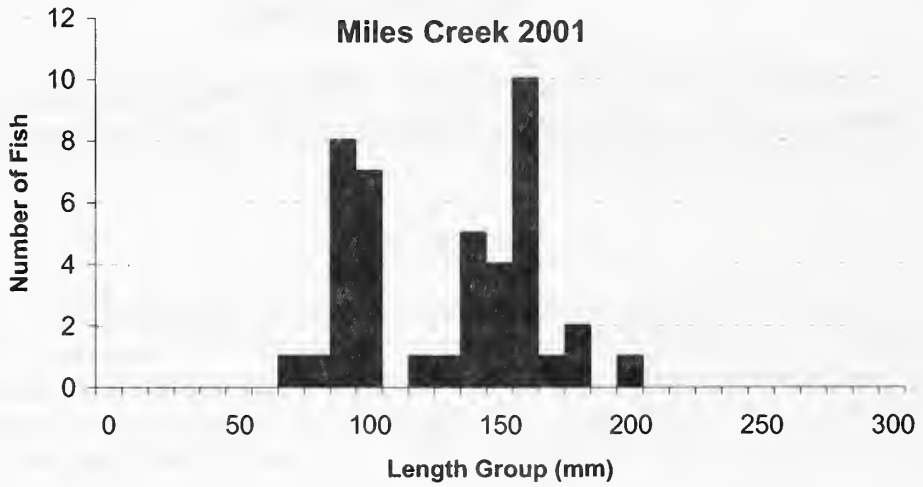

Figure 16. Length frequency histogram for Yellowstone cutthroat captured in the Miles Creek during 2001.

Detailed habitat surveys were conducted in Miles Creek at kilometers 1.2 and 3.9. The streambed at km 1.2 contained higher proportions of fine sediments (sands and silts) than was observed at km 3.9 (Table 4). Woody debris was extremely abundant at km 3.9 and moderately abundant at km 1.2, while much more spawning habitat was observed at km 1.2 (Table 4). Pools comprised about 25 to 30% by number and less than 15% by length of the two sections (Table 5). Wetted widths averaged 1.7 m in the lower section and 2.2 m in the upper section. Water depths averaged 15 cm in the lower section and 12 cm in the upper section. Fish cover was moderate to good in the lower section and low to moderate in the upper section (Table 6). Banks were stable in both sections and current riparian conditions were good. Pool quality was good in the lower section and moderate in the upper section. Habitats in the rest of the creek appeared to be good; however, fine sediments were abundant within the streambed throughout most of the stream channel. Sources of this fine sediment were believed to be primarily of natural origin, but

may have been made worse by past livestock grazing and relatively recent logging in the upper basin. This stream supported good fish densities in its lower reaches and fish abundance gradually declined in an upstream direction until flows became too low to support fish. Beaver complexes were located in the lower 1 km of the channel.

Nixon Creek

Nixon Creek enters Brackett Creek at km 17.1 from the north. Nixon Creek is about 4.6 km in length. No records of any stocking into Nixon Creek were found (Appendix B). This stream was not sampled during 2001. The stream was very small and we could not find the landowners to obtain their permission to sample.

North Fork Brackett Creek

The North Fork enters Brackett Creek at its headwaters (km 27) and is about 6.7 km long. The lower 2 km of the North Fork has a moderately low gradient of 3%, the next 0.7 km has a higher gradient of 7% and contains several very steep areas, and the uppermost portion has an extremely high gradient of 12% (Figure 17). We located what we believed to be a barrier to upstream fish movement due to a series of very steep cascades about 3.3 km above the mouth (just below our uppermost sample section; Figure 17) and we did not capture any fish immediately above this series of cascades. However, there were similarly steep areas below this cascade that we observed fish above. Habitat in the North Fork was in relatively good condition with some evidence of heavy recreational use along the lower part of the channel and past logging along the upper stream channel with some logging related woody debris evident within and adjacent to portions of the upper stream channel. No records of any stocking into the North Fork of Brackett Creek were found (Appendix B).

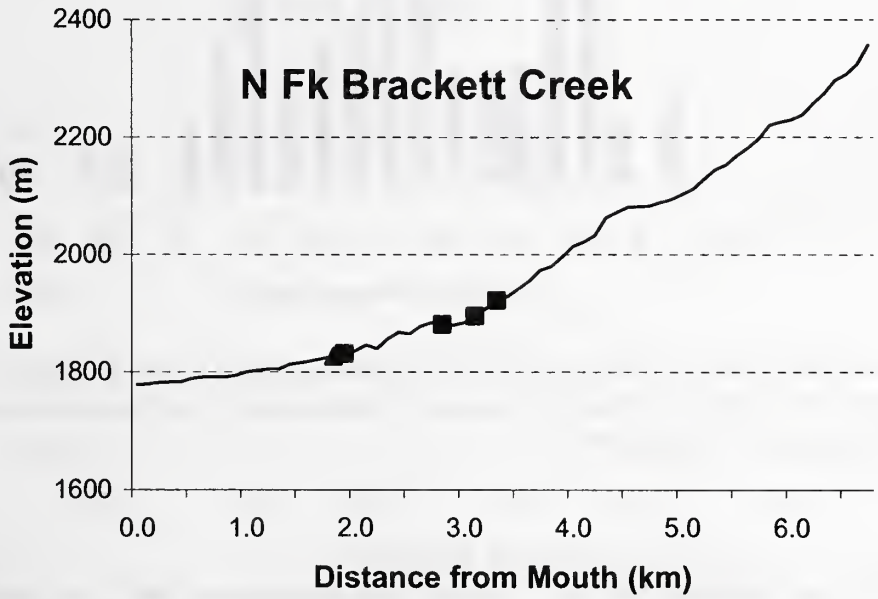

Figure 17. Elevational profile of North Fork Brackett Creek channel showing 1-pass (solid squares) and depletion (triangle) fish sampling sections.

Three sections were sampled in the North Fork during 2001 and 2002 (Figure 10). Relative abundance of trout declined in an upstream direction and YCT were relatively scarce, while brook trout were relatively abundant. No YCT were found at the uppermost section at km 2.8 (Figure 10). Genetic testing of 21 fish from the North Fork Brackett Creek collected in 1987 found no evidence of introgression (Appendix D). Fin clips from five fish from the North Fork were collected to test for introgression (Appendix C), but five fish collected in the lower Middle Fork (near the mouth of the North Fork) during 2002 were identified as being from the North Fork and will be analyzed as part of the North Fork population. No evidence of introgression was found in the five YCT collected in 2001, but the five fish collected in 2002 have not yet been analyzed (Table 1). One population estimate was conducted within the North Fork at km 1.8. This section supported an estimated 54 brook trout (SE: 1.0) and 4 YCT (SE: 0.5) 75 mm and longer (Table 2). Brook trout densities were relatively high, compared to other estimate sections in the Shields, while YCT densities were relatively low in this section (Figure 6). No intermediate-sized YCT were captured, but all size classes of brook trout were seen sampled (Table 3 and Figure 18). All captured brook trout were over 120 mm in the uppermost section (Table 3).

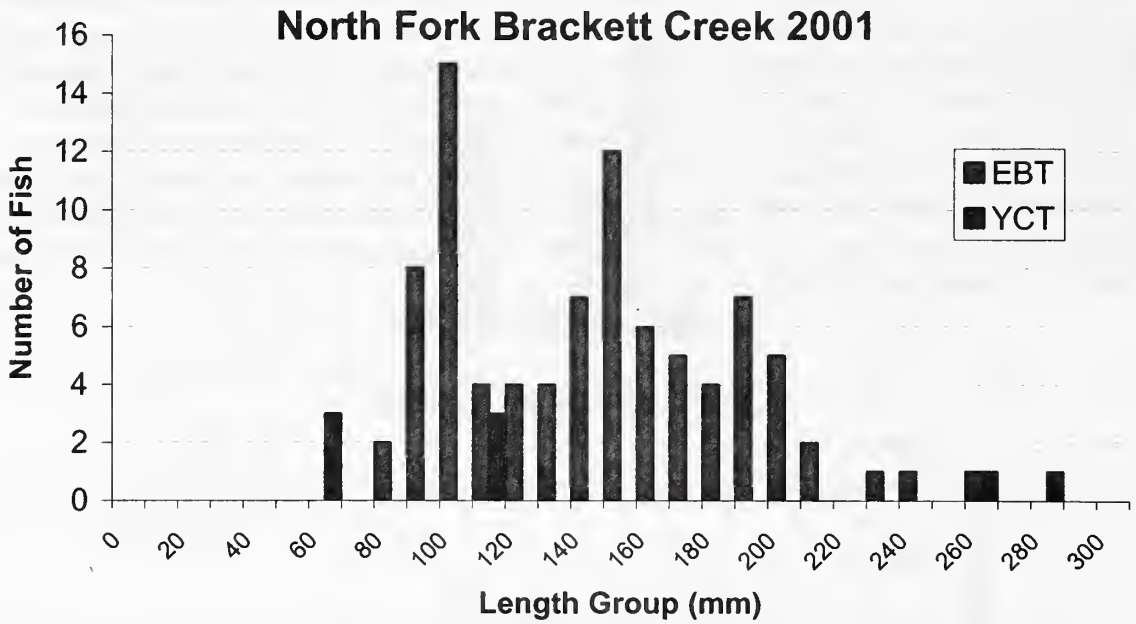

Figure 18. Length frequency histograms for brook EBT and Yellowstone cutthroat (YCT) trout captured in the North Fork of Brackett Creek above its confluence with the Middle Fork during 2001 and 2002.

A habitat survey was conducted at km 1.8 in the North Fork during 2002. At this location the streambed was predominated by small gravels and sand (Table 4). Small and large woody debris were abundant, and about 10% of the larger woody debris crossed the entire channel (Table 4). Spawning habitat was moderately abundant in this portion of the channel (Table 4). The average

wetted width of this section was 3.4 m and average depth was 18.9 cm (Table 5). Pools in this section had an average maximum depth of 43 cm, pool volumes averaged 8.3 m^3, and residual pool depth averaged 39.2 cm (Table 5). Rankings of instream cover, bank cover, bank stability, and pool quality were all relatively high, while use of the riparian area was ranked as low (Table 6).

Sheep Creek

Sheep Creek enters Brackett Creek at km 9.7 from the south and is about 4.5 km long. Sheep Creek was surveyed at three locations during 2001 and no flow was found in any of the three sections. The channel appeared to flow only during high runoff events because, although there was a defined channel, it was completely choked with vegetation. No records of any stocking into Sheep Creek were found (Appendix B).

Skunk Creek

Skunk Creek enters Brackett Creek at km 20.1 from the south and is about 5.9 km long. It has a moderate gradient (about 4%) in its lower 4.0 km where all four 1-pass electrofishing fish survey sections were located during 2001, increasing to over 13% from km 4.0 to its headwaters at km 5.9 (Figure 19). Lower Skunk Creek has numerous small property owners and the Forest Service managed lands in the upper watershed, from km 3.8 upstream. Average daily water temperatures during the summer of 2002 ranged from over 10 to 17°C (Figure 20). No records of any fish stocking into Skunk Creek were found (Appendix B).

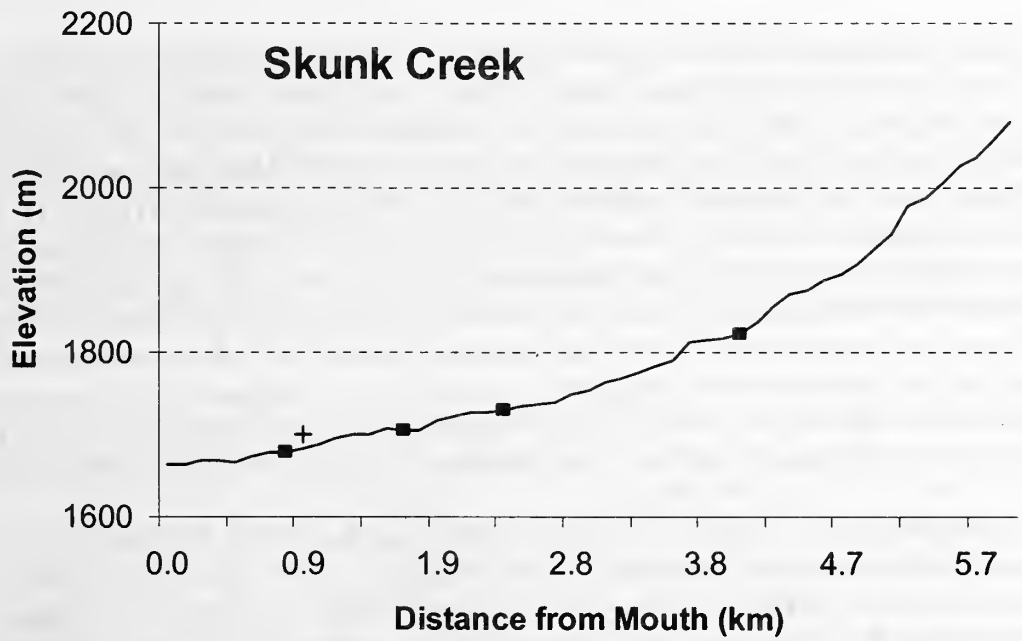

Figure 19. Elevational profile of Skunk Creek channel showing 1-pass (solid squares) fish sampling sections and location of a thermograph that recorded water temperatures during the summer of 2002 (+).

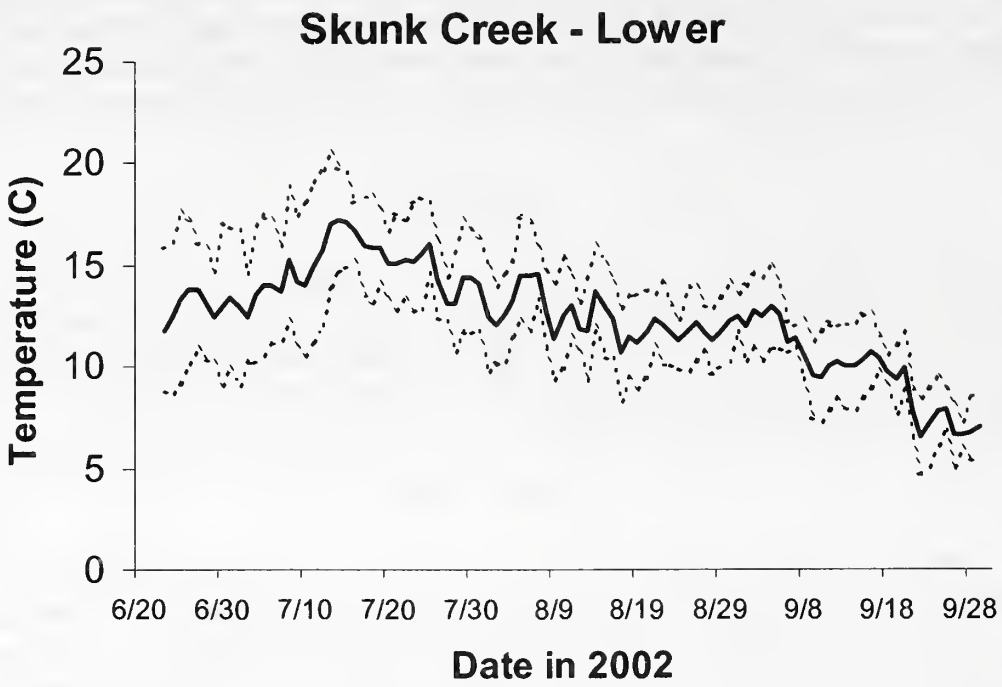

Figure 20. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in lower Skunk Creek near km 0.3 during late-June through September 2002.

YCT, brook trout, and mottled sculpin were the only fish species captured in Skunk Creek. Fin clips from 15 fish from four different sites in Skunk Creek were collected in 2001 to test for possible introgression (Appendix C). Only 13 individuals were analyzed and ten of the 13 individuals displayed only PINE fragments diagnostic of YCT, while three individuals were identified as post first generation hybrids between YCT and rainbow trout (Table 1). For all 13 samples this population of YCT was over 97% pure (Table 1). Relative abundances of YCT were extremely low in all sample sections except at km 2.5, but they were found throughout the sampled portion of the stream (Figure 10). Distribution of brook trout was relatively spotty and their abundance was relatively low. In the lowermost section, km 1.6, the battery that powered the electrofisher began to lose its charge during sampling, so estimates of relative abundance in this section were biased low. One YCT redd was observed in the uppermost section, km 3.9, although this section appeared to be heavily impacted by land use activities in the upper basin.

Average lengths of YCT captured in Skunk Creek ranged from 89 to 197 mm, while average lengths of brook trout ranged from 80 to 162 mm (Table 3). YCT up to 232 mm were captured, while brook trout ranged in length from 30 to 272 mm (Table 3 and Figure 21). Based on the number of small YCT and brook trout captured and the observation of a YCT redd, Skunk Creek likely provides spawning and rearing habitat for these species and adults from main Brackett Creek may use Skunk Creek for spawning.

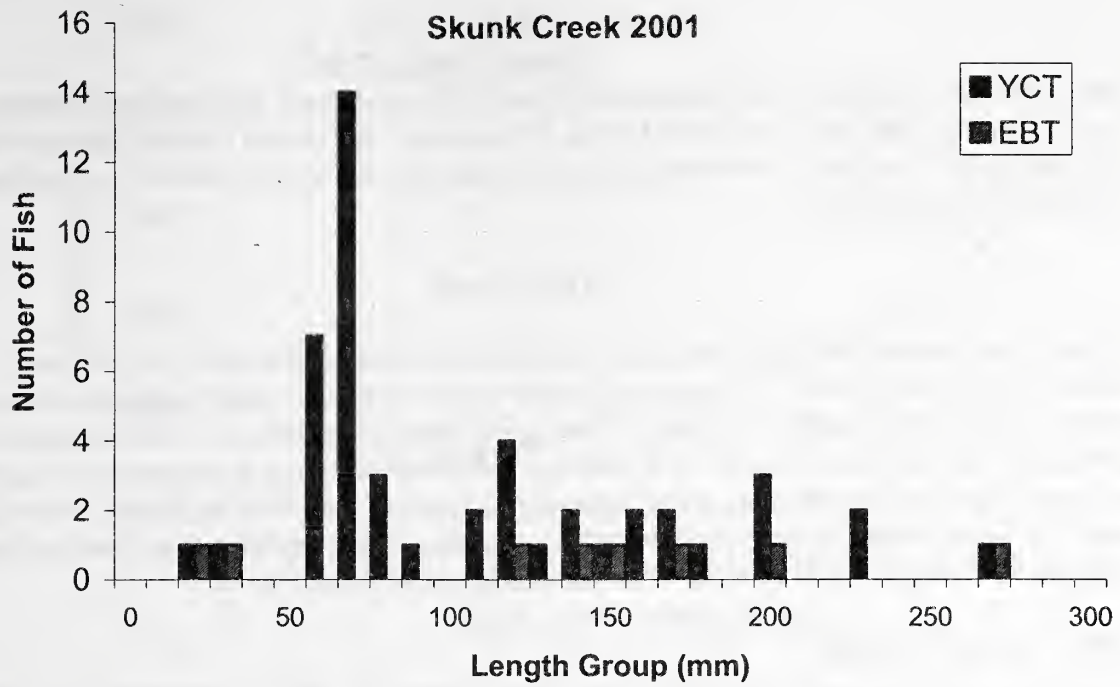

Figure 21. Length frequency histograms for Yellowstone cutthroat and brook trout captured in the four sections of Skunk Creek during 2001.

A habitat survey was conducted at km 2.5 in Skunk Creek during 2001. At this location the streambed was predominated by gravels and sand (Table 4). Small and large woody debris were moderately abundant for a channel of this small size, but little of this debris crossed the entire channel (Table 4). Spawning habitat was very abundant in this portion of the channel (Table 4). Average wetted width of this section was 2.2 m and average depth was 13.2 cm (Table 5). Pools in this section had an average maximum depth of 35.4 cm, pool volumes averaged 1.3 m^3, and residual pool volumes averaged 1.4 m^3 (Table 5). Rankings of instream cover, bank cover, bank stability, and pool quality were all relatively high, while use of the riparian area was ranked low (Table 6).

While the lower portion of Skunk Creek had many small property owners, the stream's habitat was rated as being of high quality since the stream had many high quality and complex pool habitats, good bank stability, and little riparian use. In the upstream portion on Forest Service managed lands the stream's habitat was of lower quality with relatively poor streambank stability, high fine sediment levels within the streambed, high road densities with numerous channel crossings, and many portions of the forest adjacent to the channel had been clearcut. Silt was observed on the streambed in the lower portion of Skunk Creek; however, much of this silt probably originated from upstream forest management activities. Much of the stream channel had evidence of old and recent beaver dams and recent beaver activity was observed.

South Fork Brackett Creek

The South Fork of Brackett Creek meets with the Middle and North forks to form Brackett Creek at its headwaters (km 26). The South Fork is 4.9 km long. We did no fish sampling in the South Fork during 2001 or 2002. No records of any stocking into the South Fork of Brackett Creek were found (Appendix B).

Weasel Creek

Weasel Creek enters Brackett Creek at km 22.8 from the south and is about 2.6 km long. This stream was extremely small. It appears to be dominated by groundwater (spring seep) flows. No records of any fish stocking into Weasel Creek were found (Appendix B). No fish were captured in Weasel Creek, but one 112 mm YCT and one 130 mm brook trout were captured in a small, unnamed tributary that enters Weasel Creek near its junction with Brackett Creek (Table 3). The lone YCT was genetically tested and though no evidence of introgression was found in this single fish not much can be inferred from this single sample (Table 1).

Canyon Creek Drainage

Canyon Creek drains more than 5,500 ha and flows into the Shields River near km 23.8 (Figure 1). Canyon Creek has two major tributaries, Bridgman and Grouse creeks. Its lower 11.3 km flows through the Shield-Smith Valleys level IV ecoregion, its middle 4.6 km flows through the Non-calcareous Foothill Grassland ecoregion, while its upper 5.6 km flows through the Absaroka-Gallatin Volcanic Mountains ecoregion (Figure 1; Woods et al. 1999; Appendix A).

Canyon Creek

Canyon Creek is about 21.6 km in length and has a moderately low gradient (2%) in its lower 11 km where four 1-pass electrofishing survey sections were located, increasing to 3% in the next 6 km where two population estimate and two 1-pass electrofishing survey sections were located, further increasing to 10% from km 17.3 up to its headwaters at km 21.6 where two 1-pass electrofish survey sections were located (Figure 22). Average daily water temperatures in upper Canyon Creek ranged from 10 to 16°C during the summer of 2002; however, maximum water temperatures over 20°C were recorded (Figure 23). Canyon Creek was stocked with 82,000 brown and 10,000 undesignated (likely YCT) cutthroat trout fry from 1942 to 1952 (Appendix B).

The lower 11.3 km of Canyon Creek was in open country with a willow-dominated riparian community. The stream channel was sinuous and little beaver activity was observed. The channel was entrenched through much of this portion of the stream. There were numerous high quality, lateral scour pool habitats in the lower portion of the stream. The streambed contained a relatively high proportion of fine sediments, silts and sands. From km 11.3 upstream the valley bottom became somewhat narrower, but dense willow stands continued to dominate the riparian

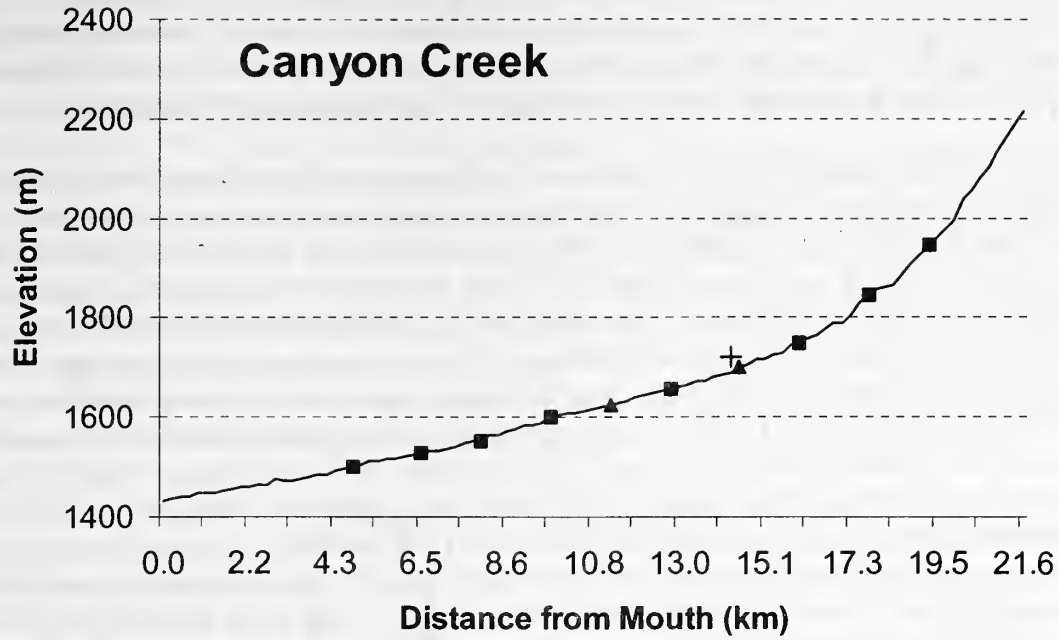

Figure 22. Elevational profile of Canyon Creek channel showing 1-pass (solid squares) and depletion population estimate (triangle) fish sampling sections and location of a thermograph that recorded water temperatures during the summer of 2002 (+).

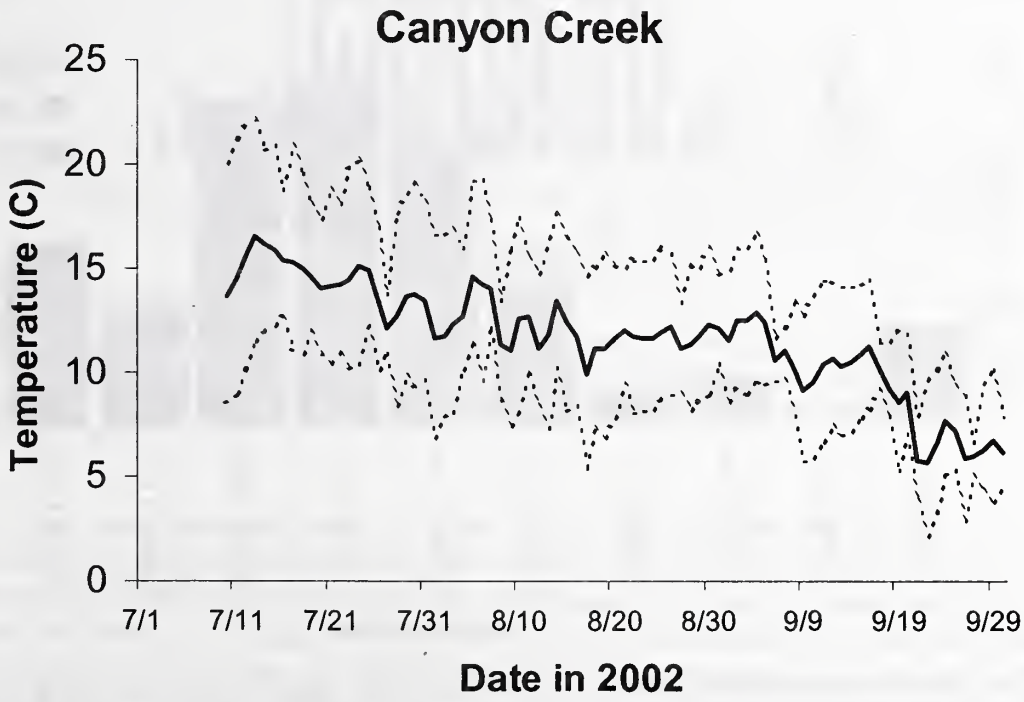

Figure 23. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in the upper portion of Canyon Creek near km 14.3 during late-June through September 2002.

community. Pools remained abundant and of high quality throughout the stream. No recent livestock damage was observed along the stream channel. A barrier was located near km 18.5 consisting of a 3 m waterfall that plunged over a bedrock shelf. This waterfall did not have a pool at its base that provided adequate depth for a fish to jump over this plunge.

Canyon Creek supported brown, brook, and Yellowstone cutthroat trout, along with mottled sculpin. No mountain whitefish or suckers were observed in this stream. There are no records of any genetic sampling conducted in Canyon Creek prior to our sampling (Appendix D). Genetic samples of 25 YCT were taken during 2001 from five different locations throughout upper (above km 11.0) Canyon Creek (Appendix C). This sample indicated the YCT in Canyon Creek were over 99% pure as 21 of the 23 individuals that were analyzed displayed only PINE fragments diagnostic of YCT, while two individuals were identified as hybrids between YCT and westslope cutthroat trout (Table 1). Electrofishing catches indicated that the relative abundances of trout were highest from km 12.5 to 15.8 (Figure 24). YCT were absent from the lowermost portion of the stream, below km 6.4. YCT were low in abundance from km 6.4 up to km 8.1, increased in abundance from above km 8.1 to km 15.8, and then declined somewhat at km 17.0. Brown trout was the only trout species observed at km 6.0, but were spottily distributed and at low abundance (Figure 23). Brook trout were absent from the lower stream from km 11.0 downstream and made up a low to moderate proportion of the catch from km 12.5 up to km 17.0.

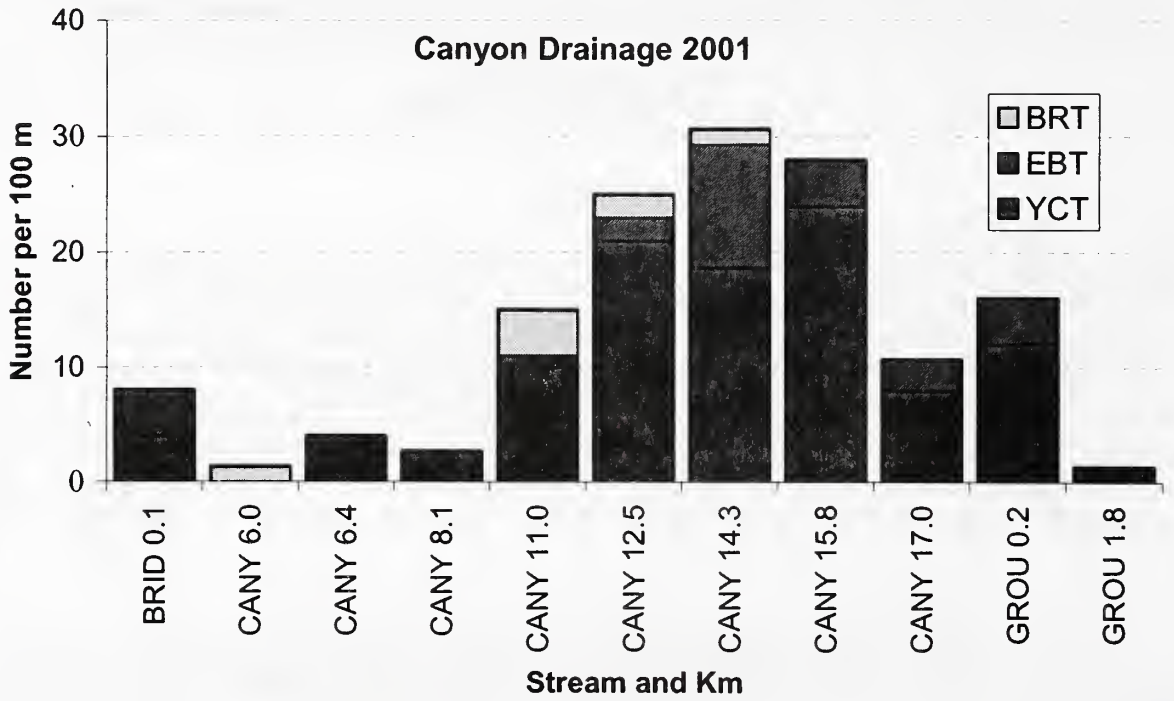

Figure 24. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) of Yellowstone cutthroat (YCT), brook (EBT), and brown (BRT) trout captured in one section of Bridgman Creek (BRID), eight sections of Canyon Creek (CANY), and two sections of Grouse Creek (GROU) during 2001 by stream kilometer.

In a 100 m sample section located at km 11.0 Canyon Creek supported an estimated 6 brown trout (SE: 0.4) and 18 YCT (SE: 1.0) 75 mm and longer (Table 2). While no brook trout 75 mm or longer were captured at this location, one 65 mm brook trout was captured. A 75 m long sample section near km 14.3 supported an estimated 9 brook trout (SE: 0.4), 1 brown trout (no SE estimated), and 15 YCT (SE: 0.3) 75 mm and longer (Table 2; Figure 6). Estimated densities of YCT were relatively high, brook trout densities were near average, and brown trout densities were relatively low in Canyon Creek compared to all density estimates made during 2001-03 (Figure 6). Average lengths of captured YCT ranged from 106 to 203 mm with larger fish captured in lower sample sections (Table 3). Average lengths of brook trout were usually shorter than YCT, while brown trout averaged longer (Table 3). Length frequencies showed that few brown trout smaller than 200 mm and numerous brown trout over 280 mm were captured (Figure 25). Some young (< 100 mm) YCT and brook trout were captured and no brook trout longer than 200 mm were captured, but many YCT were this size and longer (Figure 25).

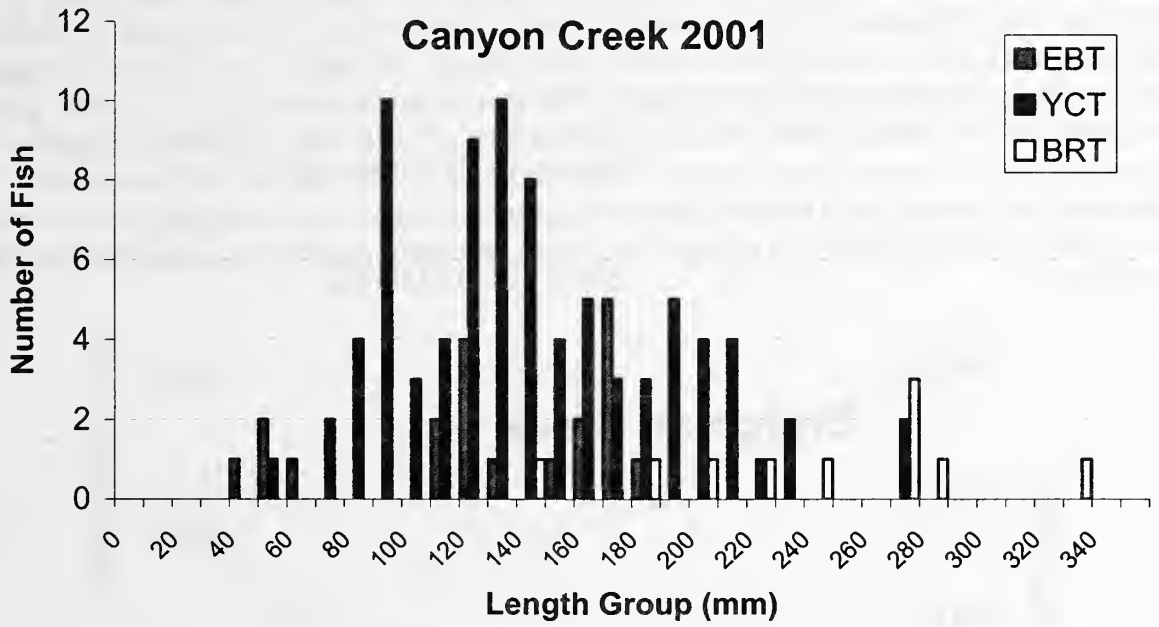

Figure 25. Length frequency histograms for Yellowstone cutthroat (YCT), brook (EBT), and brown trout (BRT) captured in the eight sections of Canyon Creek during 2001.

Habitat surveys were conducted at km 11.0 and 14.3 in Canyon Creek during 2001. At km 11.0 the streambed was predominated by small gravels and sand with almost all the streambed material composed of large gravel and smaller-sized material (Table 4). Small and large woody debris were moderately abundant, and only a few pieces of the larger woody debris crossed the entire channel (Table 4). Spawning habitat was moderately abundant in this portion of the channel (Table 4). Average wetted width of this section was 2.9 m and average depth was 19.1 cm (Table 5). Pools in this section had an average maximum depth of 61.6 cm, pool volumes averaged 5.6 m^3, and residual pool volumes averaged 6.1 m^3 (Table 5). Rankings of instream cover, bank cover, bank stability, and pool quality were all relatively high, while use of the riparian area was ranked as moderate (Table 6).

At km 14.3 the streambed was also predominated by small gravels and sand with almost all the streambed material composed of small gravel and smaller-sized material (Table 4). In this section small woody debris was moderately abundant, but few pieces of large woody debris were observed. None of the small debris, but all observed large debris crossed the entire channel (Table 4). Average wetted width of this section was 2.1 m and average depth was 14.3 cm (Table 5). Pools in this section were much smaller with an average maximum depth of 39.2 cm, average pool volume of 2.0 m^3, and residual pool volumes of 2.4 m^3 (Table 5). Rankings of instream cover, bank cover, bank stability, and pool quality were all ranked as moderate, while use of the riparian area was ranked as moderately low (Table 6).

Bridgman Creek

Bridgman Creek enters Canyon Creek near km 13.8 from the south. It has a moderately high gradient (6%) in its lower 3.0 km where all three 1-pass electrofishing fish survey sections were located during 2001, increasing to over 13% from km 3.0 to its headwaters at km 6.5 (Figure 26). No records of any stocking into Bridgman Creek were found (Appendix B). The lower portion of Bridgman Creek below km 0.5 was similar to Canyon Creek with a riparian community dominated by willow and good habitat. Upstream of km 0.5 the channel becomes much narrower and steeper and a potential barrier to upstream fish movement was observed near km 1.5. This barrier consisted of a series of very steep cascades. No fish were captured from km 1.6 upstream.

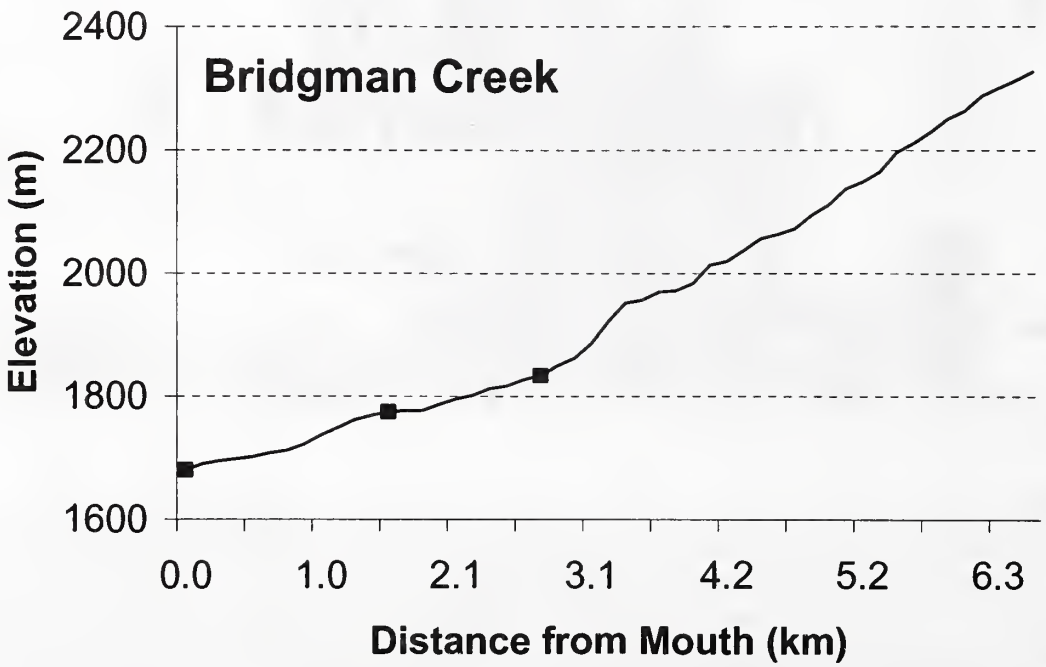

Figure 26. Elevational profile of Bridgman Creek channel showing 1-pass (solid squares) fish sampling sections.

Bridgman Creek supported brook and Yellowstone cutthroat trout, along with mottled sculpin near its mouth, but no fish were captured 1.6 or 2.7 km above its mouth (Figure 24). There are no records of any genetic sampling conducted in Bridgman Creek prior to our sampling (Appendix D). Fin clips from three YCT were taken during 2001 from the location near the mouth of Bridgman Creek for genetic analysis (Appendix C). All three of these fish had only PINE fragments characteristic of YCT with no evidence of introgression, but the extremely low sample size limits its power for detecting introgression (Table 1). The three brook trout captured near the mouth averaged 119 mm in length, while the four YCT averaged 104 mm (Table 3).

Grouse Creek

Grouse Creek enters Canyon Creek near km 14.4 from the south. It has a moderately high gradient (7%) in its lower 2.5 km where all three 1-pass electrofishing fish survey sections were located during 2001, increasing to over 10% from km 2.5 to km 4.0 and to over 15% from km 4.0 its headwaters at km 4.9 (Figure 27). A barrier to upstream fish movement was observed near km 2.4 and no fish were captured or observed above this barrier. No records of any stocking into Grouse Creek were found (Appendix B).

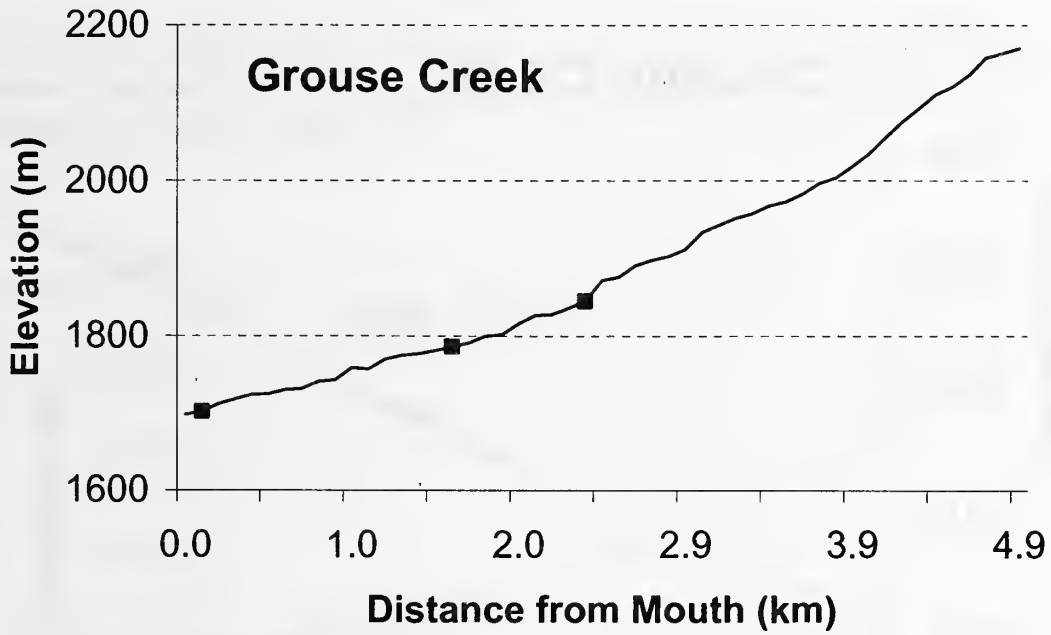

Figure 27. Elevational profile of Grouse Creek channel showing 1-pass (solid squares) fish sampling sections.

Grouse Creek supported brook and Yellowstone cutthroat trout, along with mottled sculpin, in its lower reaches. No mountain whitefish or suckers were observed in this stream. There are no records of any genetic sampling conducted in Grouse Creek prior to our sampling (Appendix D). Fin clips from six YCT were taken during 2001 from two different locations in Grouse Creek for

genetic analysis (Appendix C). All six of these fish had only PINE fragments characteristic of YCT with no evidence of introgression, but the extremely low sample size limits the statistical power for detecting introgression (Table 1). Electrofishing catches indicated that YCT were more abundant than brook trout in a section near the mouth (12 YCT per 100 m versus 3 brook trout), while only a few YCT were captured near km 1.8 (1.3 per 100 m; Figure 24). No fish were captured or seen above km 2.5. Brook trout captured in the section near the mouth averaged 156 mm (range: 125-195), while YCT averaged 95 mm (range: 40-180) near the mouth and the single YCT captured at km 1.8 was 220 mm (Table 3).

Chicken Creek Drainage

Chicken Creek is the only stream within the Chicken Creek drainage. Chicken Creek drains slightly less than 2,000 ha, is approximately 13.7 km in length, and enters the Shields River near river km 19.8 from the east. Its entire 13.7 km length flows through the Shield-Smith Valleys level IV ecoregion (Figure 1; Woods et al. 1999; Appendix A). Chicken Creek has a moderately low gradient of 2 to 3% (Figure 28). No records of any fish stocking into Chicken Creek were found (Appendix B).

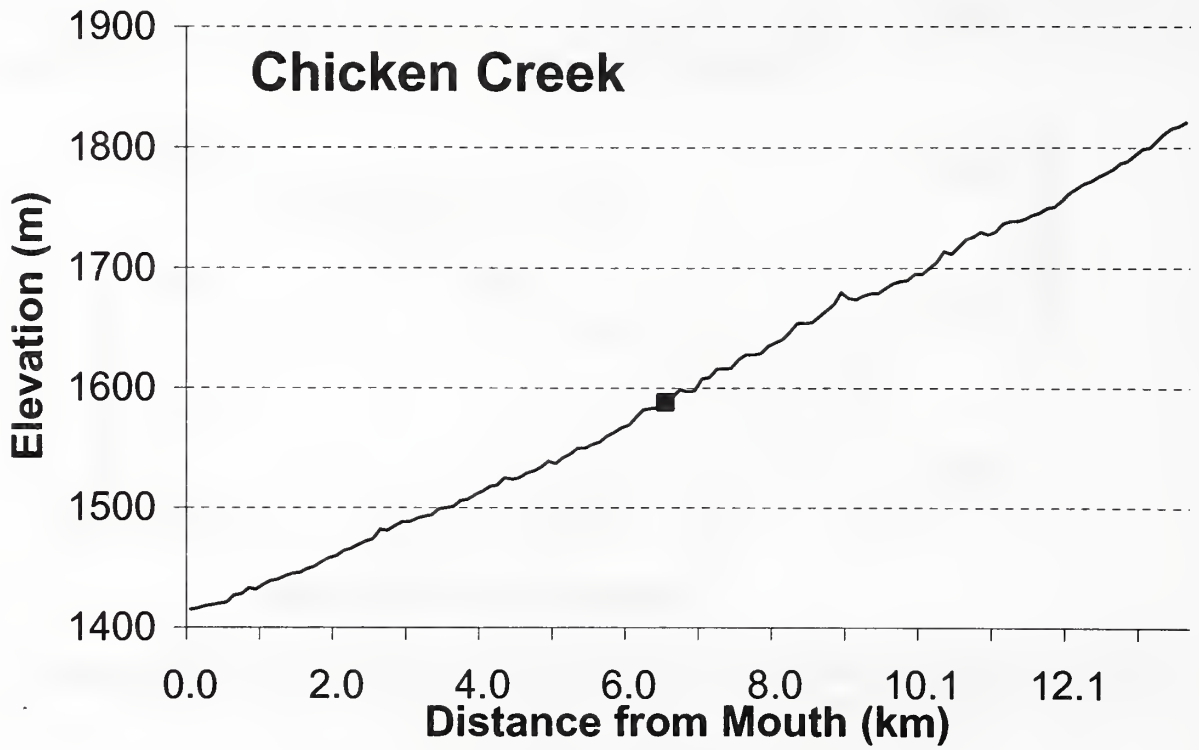

Figure 28. Elevational profile of Chicken Creek channel showing the single 1-pass (solid squares) fish sampling section.

A 75 m long section of Chicken Creek was sampled at a single location (km 6.3) on August 14, 2002. Five YCT averaging 124 mm (range: 115-137 mm) were the only fish captured during this sample event (Table 3). Fin clips were taken from all five of these fish to test their genetic status (Appendix C), but genetic testing has not yet been completed.

The stream habitat in Chicken Creek was in relatively poor condition due to extremely high levels of fine sediment covering the streambed and little riparian cover in the vicinity of the sample section. The poor habitat condition was believed related to both naturally erosive soils of the watershed and livestock impacts.

Falls Creek Drainage

Falls Creek drains about 6,600 ha and enters the Shields River from the east at river km 12.6. Its lower 15.8 km flows through the Shield-Smith Valleys level IV ecoregion and its upper 7.4 km flows through the level IV Non-calcareous foothill grassland ecoregion (Figure 1; Woods et al. 1999; Appendix A). Falls Creek has one major tributary, Mission Creek, which was not sampled.

Falls Creek

Falls Creek had a low gradient in its lower 10 km (2%), moderately low in its next 9 km (3%), and moderate in its upper 4 km (5%; Figure 29). No records of any fish stocking into the Falls Creek drainage were found (Appendix B).

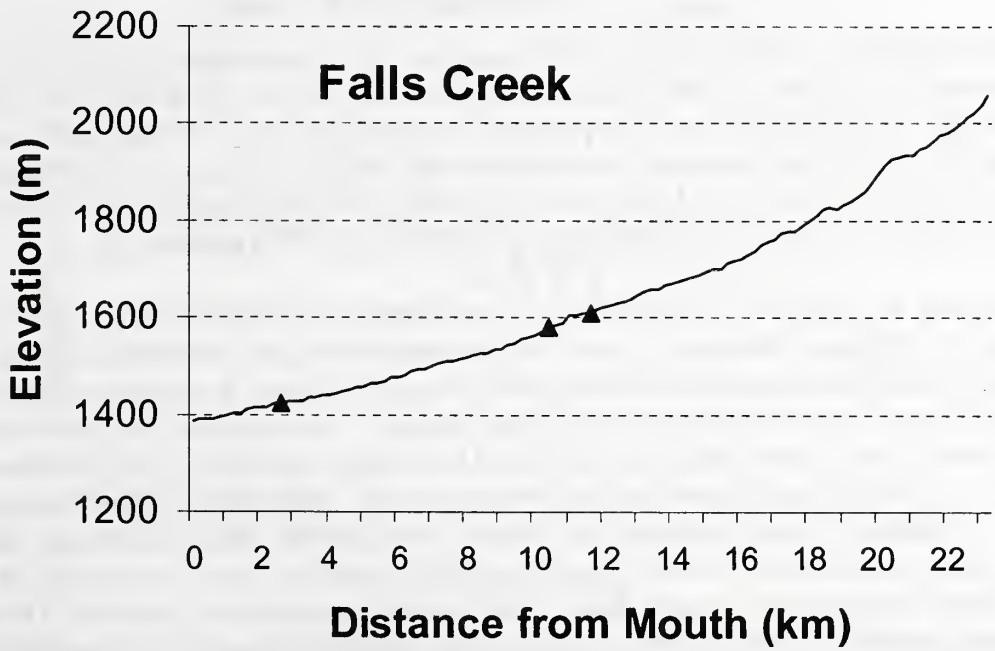

Figure 29. Elevational profile of Falls Creek channel showing the three single 1-pass (solid squares) fish sampling sections.

Falls Creek was sampled at three locations (stream kilometers 2.6, 10.4, and 11.5; Figures 1 and 29) and no fish were found at any of these locations in 2002. The stream was very boggy and had little flow in the channel at km 2.6. At kilometers 10.4 and 11.5 the streambed was covered by fine silt. A spotted frog was observed at stream km 11.5.

Flathead Creek Drainage

The Flathead Creek drainage is a relatively large, nearly 26,500 ha, drainage that has numerous named tributaries. Flathead Creek enters Muddy Creek near km 1.6, just before Muddy Creek enters Potter Creek at km 5.1 above the town of Wilsall, Montana (Figure 1). On 1:24,000 USGS contour maps main Flathead Creek is shown to enter the Shields River below the town of Wilsall, Montana. However, on most other maps, including the NHD hydrography used in GIS applications, Flathead Creek is shown entering Muddy Creek. Muddy Creek is then shown to enter Potter Creek above the town of Wilsall with Potter Creek entering the Shields River below Wilsall. Two headwater forks, the South and Middle form Flathead Creek approximately 26 km above its mouth at Muddy Creek. The South Fork of Flathead Creek is designated as Flathead Creek on some maps and Middle Fork Flathead Creek on others. While I term this portion the South Fork of Flathead Creek, it is shown on 1:100,000 USGS maps as Flathead Creek and appears that way on the NHD hydrography. Named tributaries, other than the three forks, that flow into Flathead Creek include Frazier, Fairy, Green Canyon, and Dry creeks. Major tributaries to Fairy Creek include Cache and Carrol creeks. All of Flathead Creek flows through the Shield-Smith Valleys level IV ecoregion, while the upper portions of its headwater tributaries flow through the Absaroka-Gallatin Volcanic Mountains and Absaroka-Gallatin-Madison-Bridger Sedimentary Mountains ecoregions (Figure 1; Woods et al. 1999; Appendix A).

Flathead Creek

Flathead Creek has a low gradient (< 1%) throughout its 26 km length (Figure 30). A depletion estimate and two single-pass and fish surveys were made in main Flathead Creek during 2001 (Figure 29). Average daily water temperatures ranged from 15 to 20°C during the early part of the summer of 2002 and maximum temperatures reached 24°C (Figure 31). Flathead Creek was stocked with 69,940 brook, 351,900 brown and 258,200 undesignated (likely YCT) cutthroat trout fry, and 6,710 brook trout fingerlings from 1928 to 1954 (Appendix B).

No sampling or observations were made in lower Flathead Creek (below km 12). The middle reaches of the stream (about km 12 up to km 18) consisted of an unconfined channel that flowed through grasslands and sagebrush with scattered areas of willow. Pools were relatively abundant and formed primarily by lateral scouring of the channel. Livestock use has impacted some areas of the stream channel and much of the stream's banks were unstable in this middle reach of the stream. No sampling was done from km 14 up to km 24. Immediately below the junction of the forks, the channel gradient increases and willow stands become much denser than was observed in the lower portions of the stream. Pools were still formed by lateral scouring of the channel. The channel contains more woody debris, but this debris was primarily willow. The channel in this upper reach had fewer observed impacts related to livestock and the stream's banks were much more stable than in the middle reach.

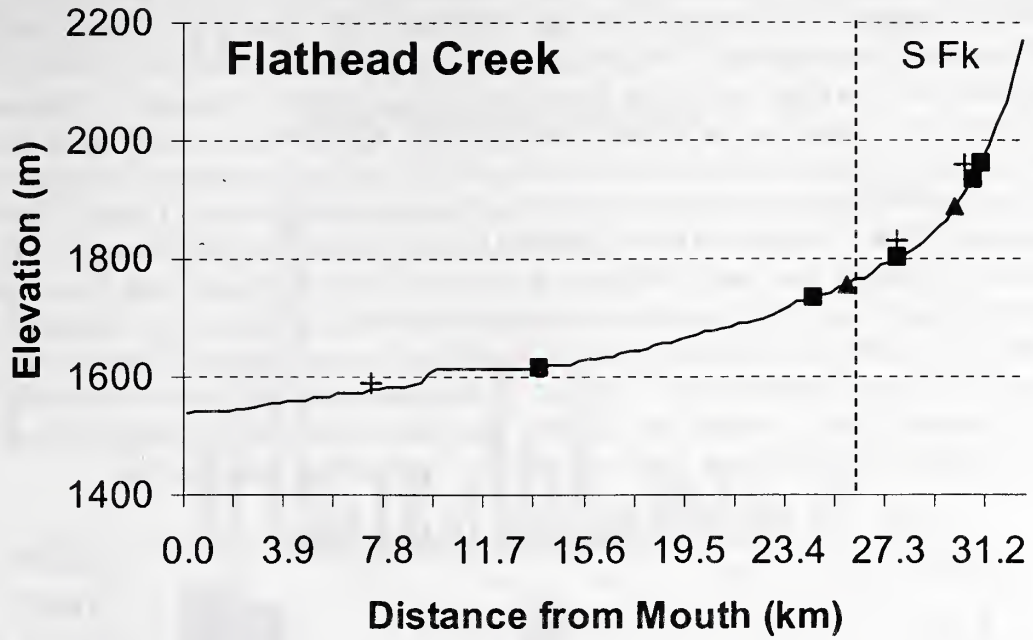

Figure 30. Elevational profile of Flathead Creek channel showing 1-pass (solid squares) and depletion (solid triangles) fish sampling sections and locations of three thermographs that recorded water temperatures during the summer of 2002 (+). The vertical dashed line indicates the mouth of the South Fork of Flathead Creek. About 5.1 km of lower Flathead Creek is not included on this graph (see "Potter Creek" below).

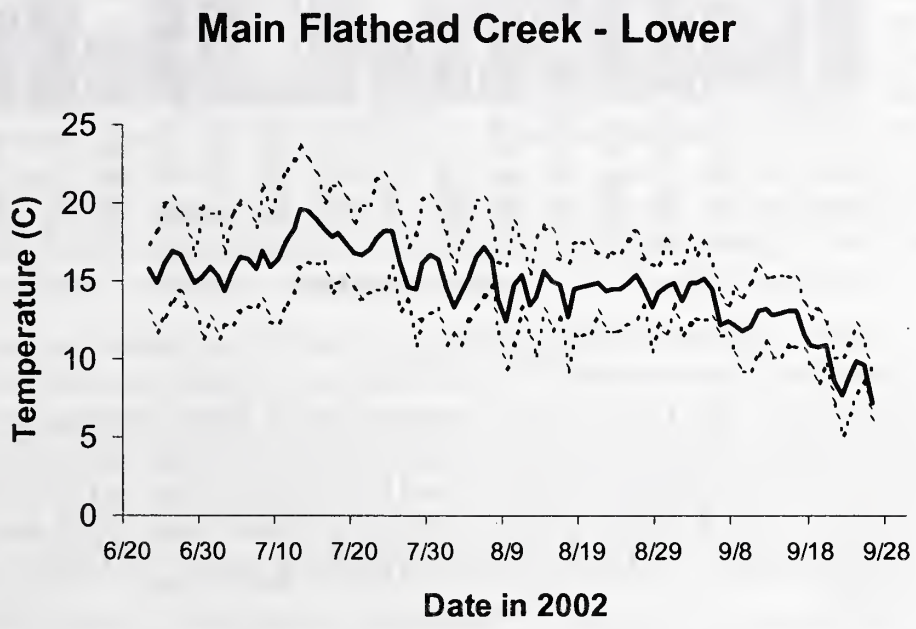

Figure 31. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in the lower portion of Flathead Creek near km 7.2 during late-June through September 2002.

Flathead Creek supports brown, brook, and Yellowstone cutthroat trout, along with mountain whitefish, longnose and white suckers, lake chub, and mottled sculpin. Genetic testing of nine YCT collected from Flathead Creek during 1990 did not find any evidence of introgression (Appendix D). Fin clips were taken from seven YCT collected at two sites in Flathead Creek during 2001 to further test for potential introgression (Appendix C). All seven of these fish had PINE fragments that were only characteristic of YCT with no evidence of introgression, but the extremely low sample size limits its power for detecting introgression (Table 1). Relative abundance of YCT was low in lower Flathead Creek, but relatively high in upper Flathead Creek (Figure 32). Brown trout were relatively abundant in lower Flathead Creek, but absent from upper Flathead Creek, while mountain whitefish were only found in lower Flathead Creek (Figure 32). Conversely, brook trout were absent from lower Flathead Creek, but relatively abundant in upper Flathead Creek. The two sucker species and lake chubs were only found in lower Flathead Creek. Mottled sculpin were abundant throughout the length of the stream. No fish population estimates were made in Flathead Creek during these surveys.

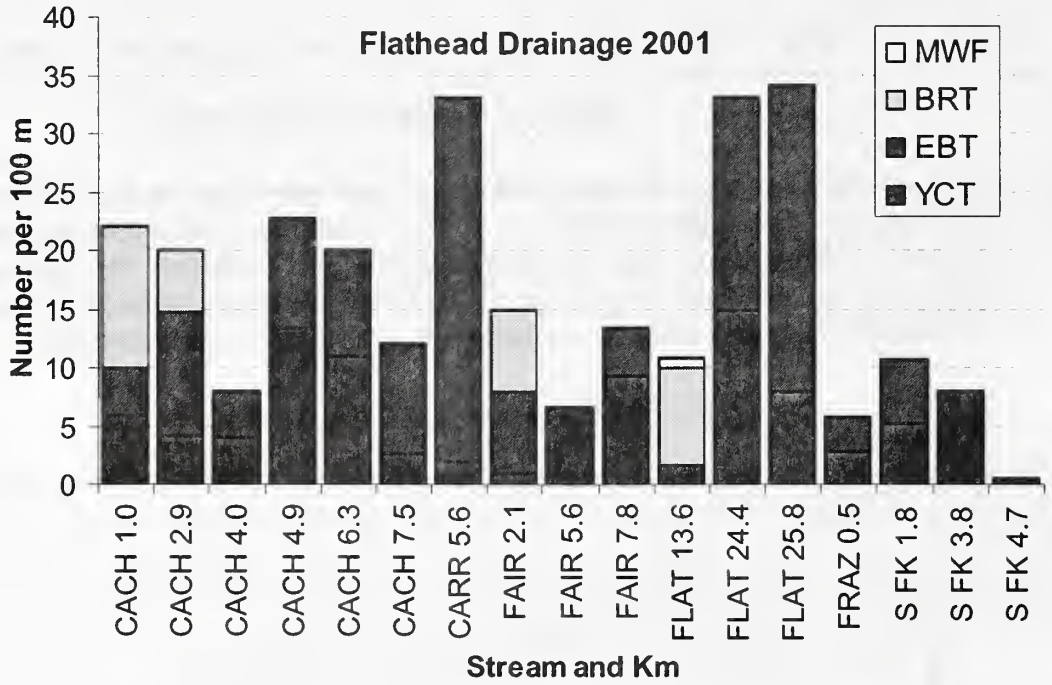

Figure 32. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) of Yellowstone cutthroat (YCT), brook (EBT), brown (BRT) trout, and mountain whitefish (MWF) captured in six sections of Cache Creek (CACH), one section of Carrol Creek (CARR), two sections of Fairy Creek (FAIR), three sections of Flathead Creek (FLAT), one section of Frazier Creek (FRAZ) and three sections of the South Fork Flathead Creek (S FK) during 2001 by stream kilometer. No fish were captured in two sections in the Middle Fork Flathead Creek.

Average lengths of captured YCT increased in a downstream direction, averaging 133 mm in the upper section and 309 mm in the lowermost (Table 3). Brook trout averaged 179 mm (range: 85-260) in length at km 24.4 and 136 mm (range: 71-277) at km 25.8 (Table 3). In the lower sample section the average length of white suckers was 238 mm (range: 108-380), longnose suckers

averaged 152 mm (range: 50-450), and creek chub averaged 82 mm (range: 74-90; Table 3). Length frequency summaries indicated that young fish (< 100 mm) of all three trout species are present in Flathead Creek (Figure 33).

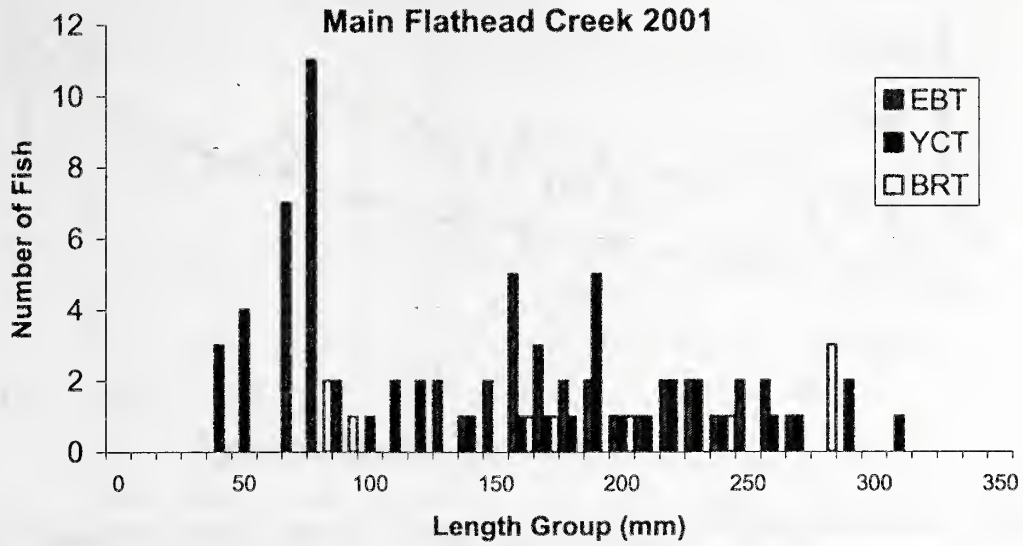

Figure 33. Length frequency histograms for Yellowstone cutthroat, brook, and brown trout captured in three sections of Flathead Creek during 2001.

A habitat survey at the uppermost sample section (km 25.8) found that the streambed in this section was dominated by cobble and large gravel (Table 4). Woody debris was moderately abundant in this section, originating mostly from willow, but none of this woody debris crossed the wetted channel. Spawning habitat was relatively abundant and spawning gravels were observed to be relatively clear of fine sediments. Wetted widths averaged 2.8 m, water depths averaged 12.9 cm, pool water depths averaged 20.8 cm, pool maximum depths averaged 46.0 cm, and pool volumes averaged 2.7 m^3 (Table 5). Ratings of instream and bank cover, bank stability, and pool quality were all moderately high, while riparian use was rated as relatively low (Table 6). Woody debris made up most of the instream cover. Some historical livestock use had impacted a few of the streambanks, but abundant woody vegetation and debris helped stabilize most of the streambanks. Some of the streambanks were also undercut.

Cache Creek

Cache Creek enters Fairy Creek near stream km 3.3 from the southeast. It has a moderately low gradient (2%) in its lower 9.0 km where all five 1-pass electrofishing and two fish population estimate survey sections were located during 2001, increasing to over 5% from km 9.0 to km 10.6 and to over 9% from km 10.6 its headwaters at km 12.0 (Figure 34). Average daily water temperatures in lower Cache Creek ranged from 11 to 16°C during the summer of 2002, while they averaged 9 to 14°C in the upper creek (Figure 35). Maximum water temperatures approached 20°C at both sites. Cache Creek was stocked with 51,000 undesignated (likely YCT) cutthroat trout fry from 1946 to 1951 (Appendix B).

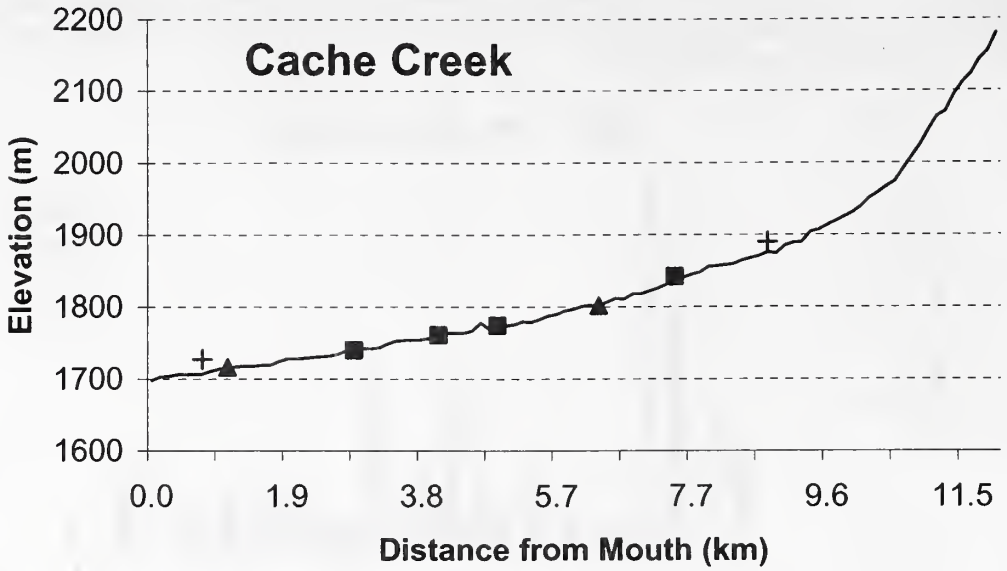

Figure 34. Elevational profile of Cache Creek channel showing 1-pass (solid squares) and depletion population estimate (triangle) fish sampling sections and locations of two thermographs that recorded water temperatures during the summer of 2002 (+).

Cache Creek supports brook trout, Yellowstone cutthroat trout, and mottled sculpin. No genetic testing of fish from Cache Creek had been done prior to 2000 (Appendix D). Fin clips were taken from 25 YCT collected at seven sites in Cache Creek during 2001 to test for potential introgression (Appendix C). Genetic analysis was completed for 22 individuals and YCT purity was over 97% for all samples and 20 of the 22 individuals displayed only PINE fragments diagnostic of YCT, while PINE fragments diagnostic of rainbow trout were found in two individuals, one of which was a first generation hybrid (Table 1). It appears introgression from rainbow trout may be relatively recent. Relative abundances of YCT were relatively high at km 4.9 and 6.3, but were moderately low at km 1.0, 2.9, 4.0, and 7.5 (Figure 32). The sample section at km 4.0 was very difficult to sample due to woody debris and thick vegetation overhanging the channel. Brown trout were only found in the lower two sections (km 1.0 and 2.9) and were most abundant in the lower section. The lowermost section (km 1.0) was 120 m long, but only 100 m could be electrofished due to dense downfall and over-channel vegetation making 20 m of channel length impossible to sample. Brook trout abundance was similar between all sites, but was lowest at km 4.0; however, poor sampling efficiency at this site likely contributed to this lower relatively abundance (Figure 32). Numerous young-of-the-year brook trout were observed, but not netted, at km 4.9.

Fish population estimates were made in two 100 m sample sections near km 1.0 and km 6.3 (Table 2; Figure 1). Cache Creek supported an estimated 12 YCT (SE: 1.2), 18 brown trout (SE: 1.0), and 8 brook trout (SE: 0.8) 75 mm and longer at km 1.0; and 14 YCT (SE: 0.8) and 14 brook trout (SE: 0.3) at km 6.3. Estimated densities were moderately low for both YCT and brook trout (Figure 6). Average lengths of YCT increased in an upstream direction from km 1.0 to km 4.0 increasing from 128 to 191 mm between these three sections, then declined (137 to

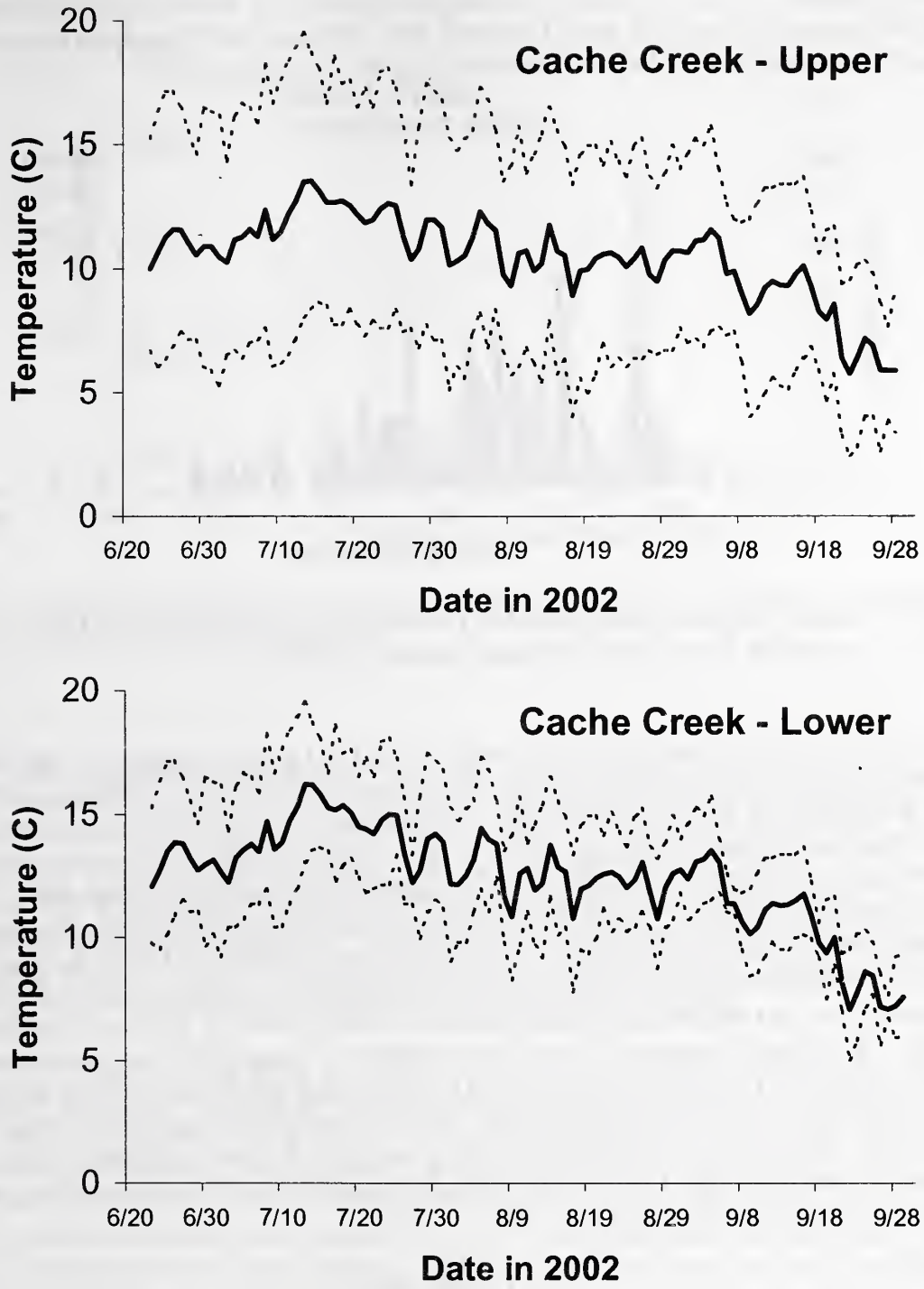

Figure 35. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in upper (top; 3.3) and lower (bottom; km 0.7) Cache Creek during late-June through September 2002.

100 mm) from km 4.9 to 7.5 (Table 3). Average lengths for the other two trout species were generally between 120 and 160 mm. Fish from 60 to 250 mm of all three trout species were captured including a couple larger brown trout over 300 mm (Figure 36).

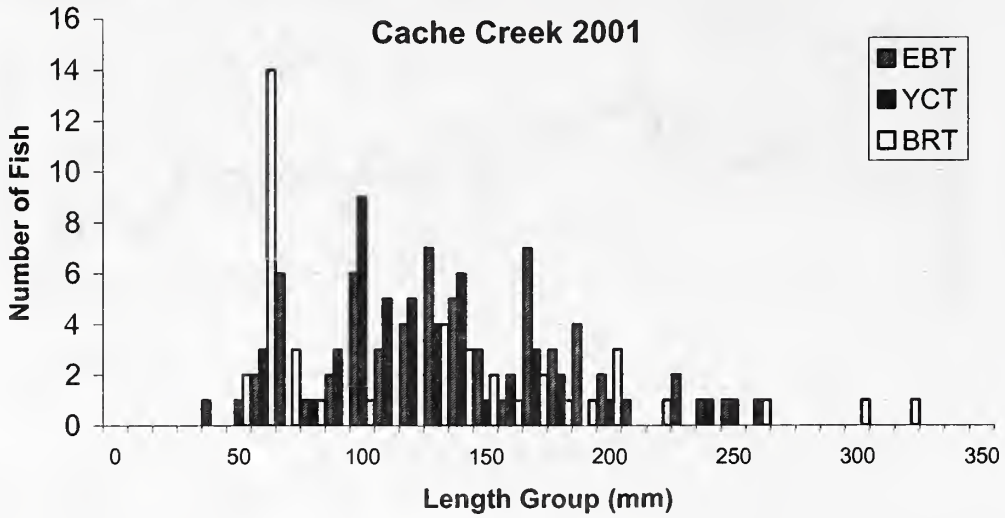

Figure 36. Length frequency histograms for Yellowstone cutthroat, brook, and brown trout captured in five sections of Cache Creek during 2001.

Habitat surveys were conducted at km 1.0 and 6.3. At km 1.0 the streambed of Cache Creek was predominated by cobble and gravels, while silt predominated at km 6.3 (Table 4). Small woody debris were present at km 1.0, but were not very abundant, while large debris were rare. No woody debris was found to span the channel at this location. Small debris was very abundant at km 6.3, while large debris was scarce at this location, though some of this large debris spanned the entire channel (Table 4). Spawning habitat was relatively abundant at km 1.0 and rated as excellent, but was relatively rare at km 6.3 with lots of silt (Table 4). At km 1.0, wetted widths averaged 3.8 m, water depth averaged 12.1 cm, pool depths averaged 22.0 cm, pool volumes averaged 4.8 m^3, and residual pool depths averaged 5.9 m^3 (Table 5). At km 6.3 wetted widths averaged 3.0 m, depths averaged 25.0 cm, pool volumes averaged 3.3 m^3, and maximum pool depths averaged 61.4 cm. Instream cover was relatively high in both sections and was formed primarily by small woody debris, while bank cover was moderately high with undercut banks and vegetation (Table 6). Pool quality was very good at km 6.3, but only moderate at km 1.0. Riparian use was moderate at km 6.3 and use was primarily related to beaver activity at this site, but use was relatively low at km 1.0.

Carrol Creek

Carrol Creek enters Fairy Creek near stream km 0.2 from the west. It has a moderately low gradient (< 2%) throughout its 5.7 km length (Figure 37). Two tributaries, the North and South forks, meet to form Carrol Creek about 5.7 km above its mouth at Fairy Creek. A depletion fish population estimate was done in one section of Carrol Creek during 2001. Carrol Creek was stocked with 10,000 undesignated (likely YCT) cutthroat trout fry from 1945 to 1949 (Appendix B).

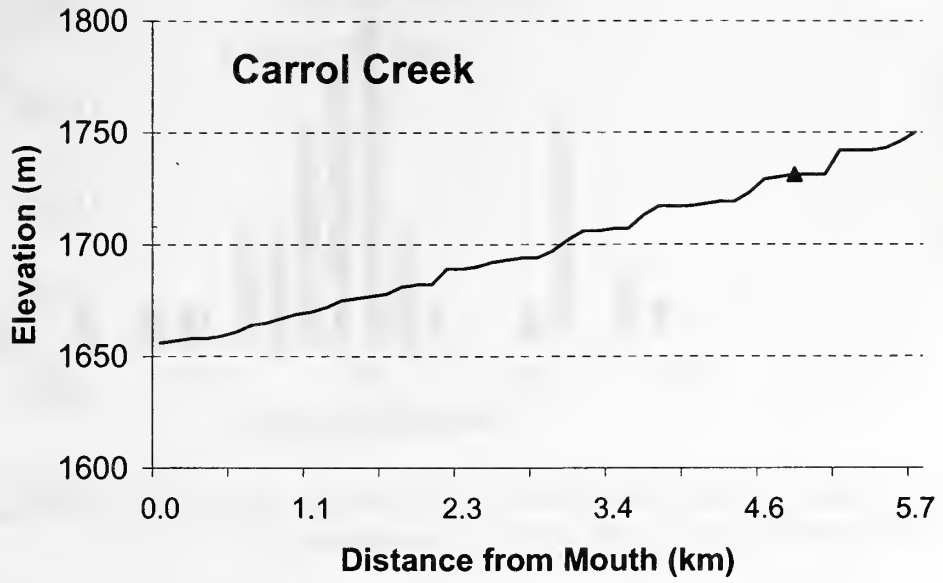

Figure 37. Elevational profile of Carrol Creek channel showing a depletion estimate (solid triangle) fish sampling section.

Carrol Creek was sampled immediately below the junction of the North and South forks. This portion of the stream contained good fish habitat. The channel meandered through a low gradient meadow with occasional sparse willow stands. Evidence of past livestock use was observed with a few sheared streambanks and fine sediments in the streambed. Pool habitats were relatively abundant and contained good cover in the form woody debris and water depth. Streambanks were moderately stable. The habitat of the North Fork of Carrol Creek appeared to be marginal for fish. While the South Fork of Carrol Creek appeared to contain suitable habitat, the landowner would not give us permission to sample this fork in 2001.

Carrol Creek supports brook trout, Yellowstone cutthroat trout, and mottled sculpin. No amphibians were seen. No evidence of introgression was found through genetic testing of 19 YCT collected from Carrol Creek and 11 YCT collected from the South Fork of Carrol Creek during 1987 (Appendix D). Fin clips were taken from two YCT collected at one site in Carrol Creek during 2001 to further test for potential introgression (Appendix C) and while no evidence of introgression was found, this evidence is not at all conclusive due to the small sample size (Table 1). Brook trout were very abundant, while YCT were relatively scarce in the single sample section of Carrol Creek located at km 5.6 (Figure 32). This section supported an estimated 46 brook trout (SE: 1.6) and 2 YCT (SE could not be estimated because all fish captured on the first pass) 75 mm and longer (Table 2). Lengths of captured YCT averaged 175 mm, while the 48 captured brook trout averaged 158 mm (Table 3). Several length classes of brook trout were present (Figure 38).

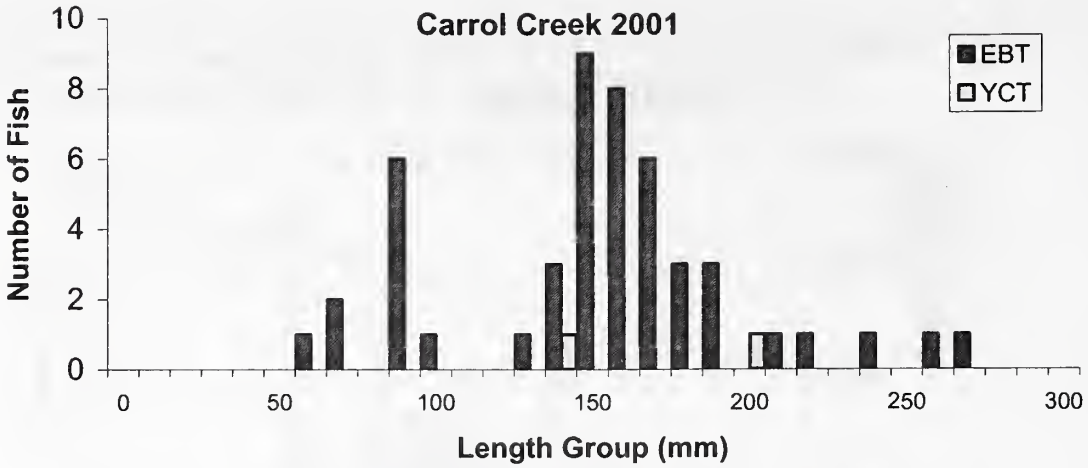

Figure 38. Length frequency histograms for Yellowstone cutthroat, brook, and brown trout captured in five sections of Cache Creek during 2001.

A habitat survey was conducted in the sample section in Carrol Creek located near km 5.6. Carrol Creek's streambed at this location contained nearly equal proportions of silt, small gravel, large gravel, and cobble (Table 4). Small woody debris was moderately abundant, but large woody debris was relatively rare (Table 4). About half of the large woody debris crossed the wetted channel. Spawning habitat was abundant, but fine sediments in the spawning gravels lowered the quality of these gravels for spawning. Wetted widths averaged 2.0 m, water depths averaged 14 cm, average water depths in pools averaged 20.2 cm, maximum pool depths averaged 43.2 cm, and pool volumes averaged 2.0 m^3 (Table 5). Instream cover was rated as moderated, but bank cover, bank stability, and pool habitat quality were rated as moderately high or high (Table 6). Undercut banks, vegetation, and woody debris provided bank cover. Woody debris provided the only instream cover. Riparian use was rated as moderately low and was related to past livestock use that led to some sheared streambanks.

Dry Creek

No sampling of the Dry Creek drainage occurred during 2001. No records of any stocking into the Dry Creek drainage were found (Appendix B).

Fairy Creek

Fairy Creek (also called Fairy Lake Creek) enters Flathead Creek at km 18.6 from the south. On some maps the portion of Fairy Creek between the mouth of Cache Creek and Flathead Creek is labeled as Cache Creek. The USGS NHD hydrography layer labels this as Fairy Creek and this is the convention I followed. Fairy Creek has a moderately low gradient (< 2%) in its lower 7.5 km where both 1-pass electrofishing fish survey sections were located during 2001, increasing to over 5% from km 7.5 to km 12.6 and to over 12% from km 12.6 its headwaters at km 16.2 (Figure 39). Average daily water temperatures in Fairy Creek were between 10 and 14°C during the summer of 2002 (Figure 40). Cache and Carrol creeks are tributaries to Fairy Creek. Fairy

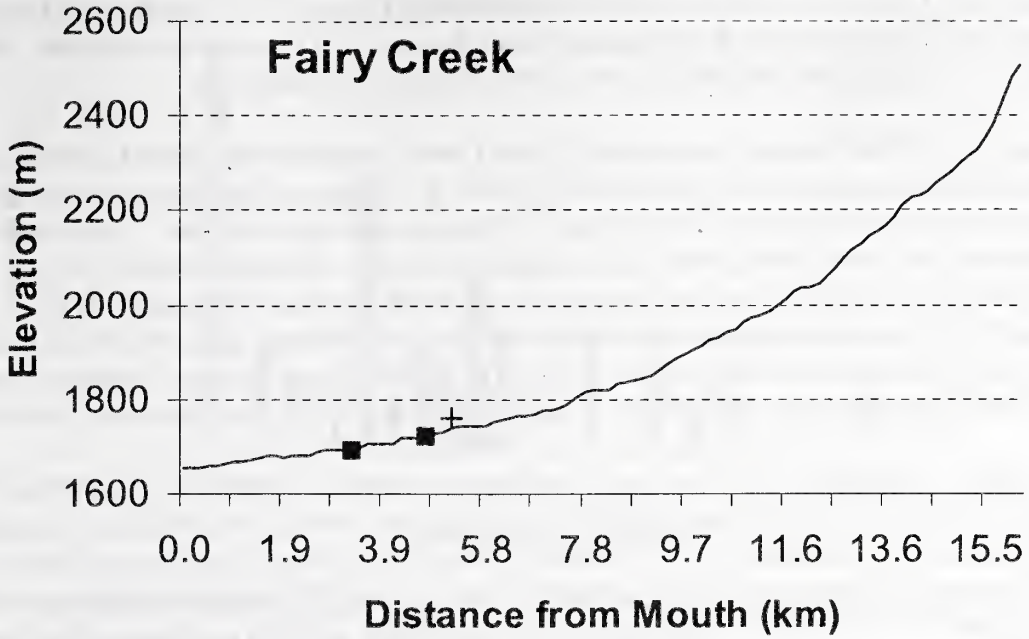

Figure 39. Elevational profile of Fairy Creek channel showing 1-pass (solid squares) fish sampling sections and location of thermograph that recorded water temperatures during June-September 2002 (+).

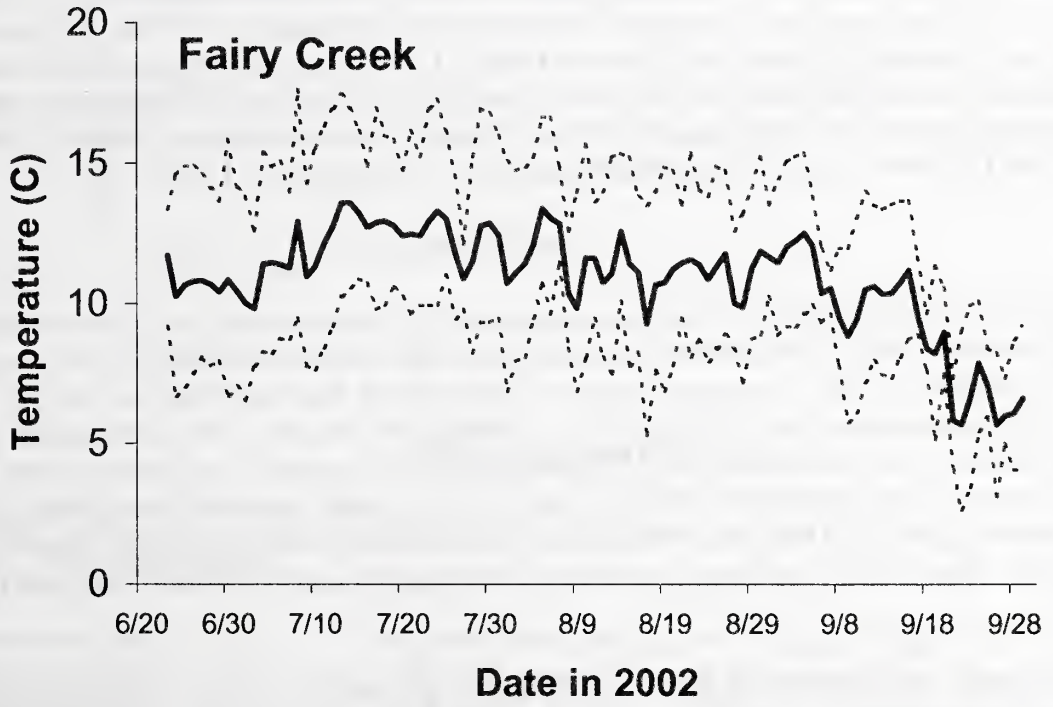

Figure 40. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in Fairy Creek near km 5.1 during late-June through September 2002.

Creek was stocked with 31,000 undesignated (likely YCT) cutthroat trout fry from 1945 to 1951; while Fairy Lake was stocked with 7,020 undesignated (likely YCT) cutthroat, 12,112 Yellowstone cutthroat, and 4,500 rainbow trout fry; and 2,118 westslope cutthroat, 20,592 YCT, and 3,750 rainbow trout fingerlings from 1950 to 2001 (Appendix B).

Lower Fairy Creek, below the mouth of Cache Creek, has numerous small landowners and much of the channel appeared to be impacted by livestock. At km 5.6 the riparian community was dominated by willow and evidence of heavy livestock use was observed. The streambed in this portion of the channel contained a high proportion of fine sediment, believed to have originated from the stream's banks, from both natural erosion and livestock trampling. At km 7.7 the valley bottom was more open; the riparian community was still dominated by willow; but there was less evidence of recent livestock impacts, although evidence of past livestock impacts were observed. Less fine sediments were also observed within the streambed in this portion of the channel.

Fairy Creek supports YCT, brook trout, and mottled sculpin. Genetic testing of three YCT collected from Fairy Creek during 1990 did not find any evidence of introgression (Appendix D). Fin clips were taken from 11 YCT collected at two sites in Fairy Creek during 2001 to further test for potential introgression (Appendix C). Ten of these fish were analyzed and no evidence of introgression was found, but the sample size is still too small to conclude with certainty that no introgression exists (Table 1). The relative abundance of YCT was low in the portion of Fairy Creek below Cache Creek, while brown trout abundance was relatively high (Figure 32). The relative abundance of YCT increased in an upstream direction, while brown trout were absent from Fairy Creek above Cache Creek. Brook trout were relatively abundant in the lower and upper sections (km 2.1 and 7.8), but none were captured in the middle section (km 5.6; Figure 32). A 75 m long sample section at km 5.6 supported an estimated 6 YCT (SE: 0.5) and 2 brook trout (no estimate of SE possible) 75 mm and longer (Table 2; Figure 6). These estimates represented a moderate density of YCT and a low density of brook trout compared to other estimates (Figure 6). Average lengths of trout in Fairy Creek were relatively short and only two YCT and four brown trout were over 200 mm (Table 3 and Figure 41).

Frazier Creek

Frazier Creek enters Flathead Creek near stream km 25.6 from the south and has a moderately high gradient (> 5%) in its lower 3.5 km where the single 1-pass electrofishing survey section was located during 2001, increasing to over 10% from km 3.5 to km 7.0 and to over 26% from km 7.0 its headwaters at km 7.7 (Figure 42). A single tributary, the North Fork Frazier Creek, enters Frazier Creek near stream km 2.5 from the west. No records of any stocking into Frazier Creek were found (Appendix B). Frazier Creek is a very small stream and has dense willow stands along its lower 2 km. It has few pools in this lower area and fish habitat was rated as marginal. Above km 2, the stream was deemed too small to support fish and was nearly dry in 2001.

Frazier Creek supports low numbers of brook trout, Yellowstone cutthroat trout, and mottled sculpin. No previous genetic testing has been done for fish from Frazier Creek (Appendix D).

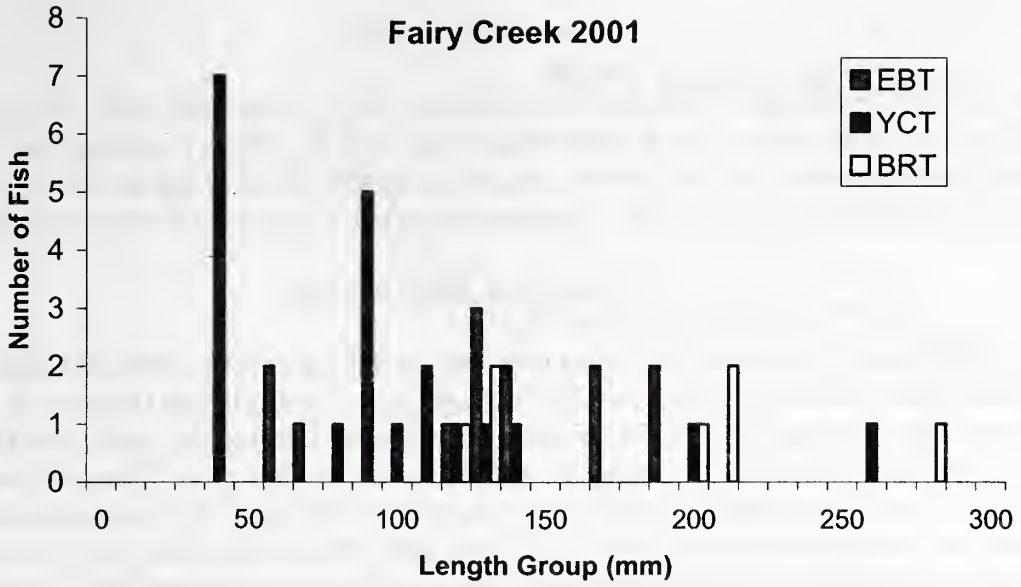

Figure 41. Length frequency histograms for Yellowstone cutthroat, brook, and brown trout captured in three sections of Fairy Creek during 2001.

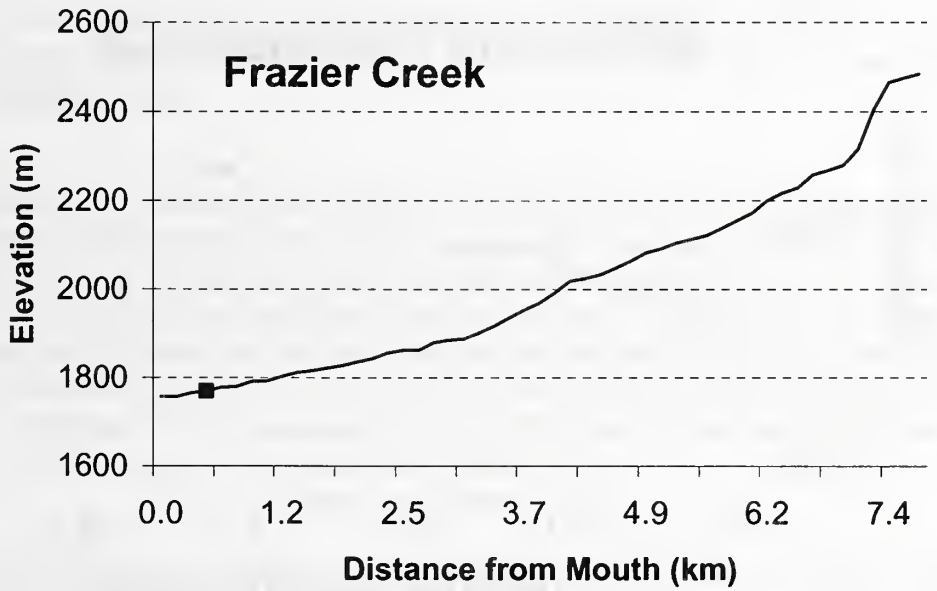

Figure 42. Elevational profile of Frazier Creek channel showing the 1-pass (solid square) fish sampling section.

Fin clips were taken from two YCT collected at one site in Carrol Creek during 2001 to test for potential introgression (Appendix C) and while no evidence of introgression was found, this evidence is not at all conclusive due to the small sample size (Table 1). Neither brook nor Yellowstone cutthroat trout were abundant in Frazier Creek (Figure 32). Lengths of the two captured YCT averaged 105 mm, while the two captured brook trout averaged 120 mm (Table 3). No habitat survey was conducted in Frazier Creek.

Green Canyon Creek

Green Canyon Creek enters Flathead Creek at stream km 17.0 from the south. No records of any stocking into Green Canyon Creek were found (Appendix B). Green Canyon Creek was sampled in two locations and this stream was too small and probably contained too much silt at the lower sample site to support fish. Upstream from km 3.2 the stream was dry in 2001.

Middle Fork Flathead Creek

The Middle Fork of Flathead Creek joins with the South Fork to form Flathead Creek. It has a moderately low gradient (slightly over 2%) throughout its 5.5 km length (Figure 43). Average, maximum and minimum daily water temperatures fluctuated during the early part of the summer, but were very stable after July 25 suggesting that after the surface run-off period flows in the Middle Fork may be maintained primarily by groundwater (Figure 44). During the early summer average daily temperatures were around 15°C, but after July 25 they stabilized at about 10°C. One-pass electrofishing surveys were done in two sample sections during 2001. No records of any fish stocking into the Middle Fork Flathead Creek were found (Appendix B).

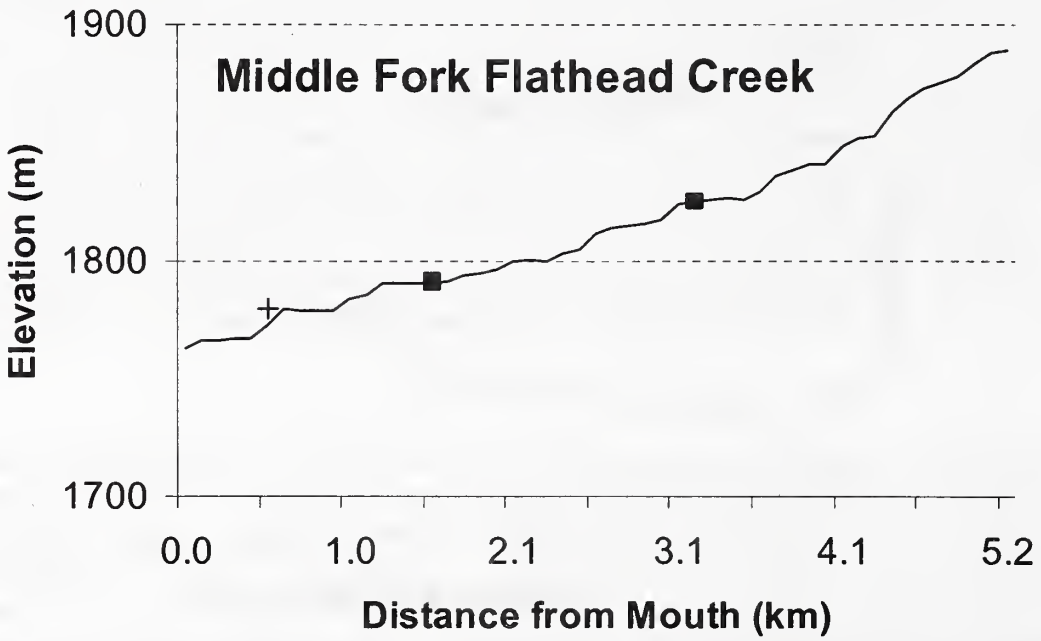

Figure 43. Elevational profile of the Middle Fork of Flathead Creek channel showing 1-pass (solid squares) fish sampling sections and the location of a thermograph that recorded water temperatures during late-June through September 2002 (+).

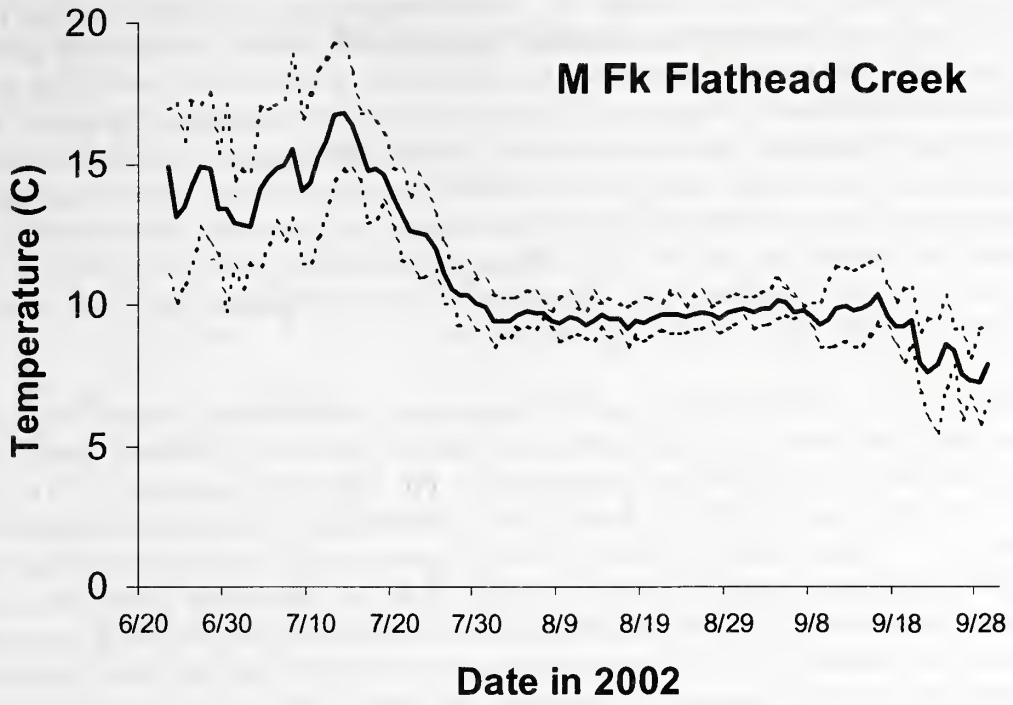

Figure 44. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in the Middle Fork Flathead Creek near km 0.5 during late-June through September 2002.

The lower 2 km portion of the Middle Fork was dominated by willow, but livestock impacts were still severe in this portion of the stream. Streambanks were unstable and broken down and fine sediments made up a moderately high proportion of the streambed material. Above km 2, the channel was poorly defined and flowed through a marsh. This portion of the channel was deemed unsuitable for fish and no fish were captured in two sample sections of the Middle Fork located near kilometers 1.4 and 3.4, although a fry of undetermined species was observed in the lower section. Mottled sculpin and numerous spotted frogs were observed at this lower site.

North Fork Flathead Creek

The North Fork of Flathead Creek enters main Flathead Creek near km 22.3, about 3.7 km below the confluence of the Middle and South forks. The North Fork of Flathead Creek was stocked with 10,000 brown and 25,000 undesignated (likely YCT) cutthroat trout fry from 1945 to 1951 (Appendix B). No sampling was conducted within the North Fork during these surveys.

South Fork Flathead Creek

The South Fork of Flathead Creek joins with the Middle Fork to form Flathead Creek. The South Fork is designated as main Flathead Creek on some maps (see "Flathead Creek Drainage" section above). It has a channel gradient of about 4% (upstream of km 26 on Figure 30). The South Fork was stocked with 20,000 brown and 10,000 undesignated (likely YCT) cutthroat

trout fry from 1945 to 1951 (Appendix B). Water temperatures in the upper portion (km 4.2) of the South Fork were relatively cool, but were about 2 to 4°C warmer in the lower portion (km 1.8; Figure 45). The riparian community along the lower 2.0 km of the South Fork was dominated by willow and evidence of livestock use was low to moderate. From km 3.0 upstream Douglas fir and lodgepole pine dominated the riparian community and livestock impacts were more noticeable. Livestock damage to the channel was observed near km 4.5 resulting in damaged streambanks, an over-widened stream channel, and abundant fine sediments within the streambed. A perched road culvert above the sample section at km 4.5 was believed to be at least a partial barrier to upstream fish movement. This culvert created about a 0.75 m drop and there was no plunge pool at the base of this culvert.

The South Fork of Flathead Creek supports brook trout, Yellowstone cutthroat trout, and mottled sculpin. Previous genetic testing of seven fish from the South Fork Flathead Creek in 1990 found no evidence of introgression (Appendix D). Fin clips were taken from 14 YCT collected at three locations in the South Fork during 2001 to further test for potential introgression (Appendix C). These samples indicated some introgression with westslope cutthroat trout (overall they had about 4.5% introgression), but 9 of the 14 individuals displayed only PINE fragments diagnostic of YCT, while five individuals were identified as hybrids between YCT and westslope cutthroat trout. Fish sampling was conducted at four sites in the South Fork. Brook trout were only present at the lowermost sample site (km 1.8) and their relative abundance was moderate at this site (Figure 32). This lower sample site contained very few pool habitats. No fish were captured at the uppermost sample site (km 4.7), while YCT were present at the three lower sample sites; however, their abundance was moderate to low at all three of these locations (Figure 32). Numerous young-of-the-year YCT were observed, but not netted, at km 3.8 and spotted frogs were also observed at this site. A population estimate conducted in a 100 m sample section located near km 3.8 estimated that this section supported 9 YCT (SE: 0.4) 75 mm and longer (Table 2; Figure 6). The estimated density of YCT 75 mm and longer was moderate in this section compared to other sections sampled during these surveys (Figure 6). Average lengths of YCT ranged from 80 to 136 mm in the three sections where they were captured, while the 15 brook trout captured in the lower section averaged 92 mm (Table 3). Length frequency information showed that all captured YCT were smaller than 150 mm while brook trout ranged from 60 to 250 mm (Figure 46; Table 3).

A habitat survey conducted near km 3.8 found that the streambed in this section was composed primarily of cobbles and large and small gravels (Table 4). The channel in this section contained a moderate amount of small and large woody debris and about a third of this debris crossed the wetted channel (Table 4). Spawning habitat was moderately abundant and relatively clean of fine material. Wetted widths average 1.7 m, water depth averaged 7.1 cm, pool depths averaged 11.7 cm, maximum pool depths averaged 23.3 cm, and pool volumes averaged 0.4 m3 (Table 5). Rankings of instream and bank cover; streambank stability, and pool habitat quality were all moderate to moderately high (Table 6). Instream cover was provided mostly by woody debris. Bank stability was provided by woody debris and vegetation, while undercut banks and woody debris provided bank cover. Riparian use was moderately low and related to livestock use.

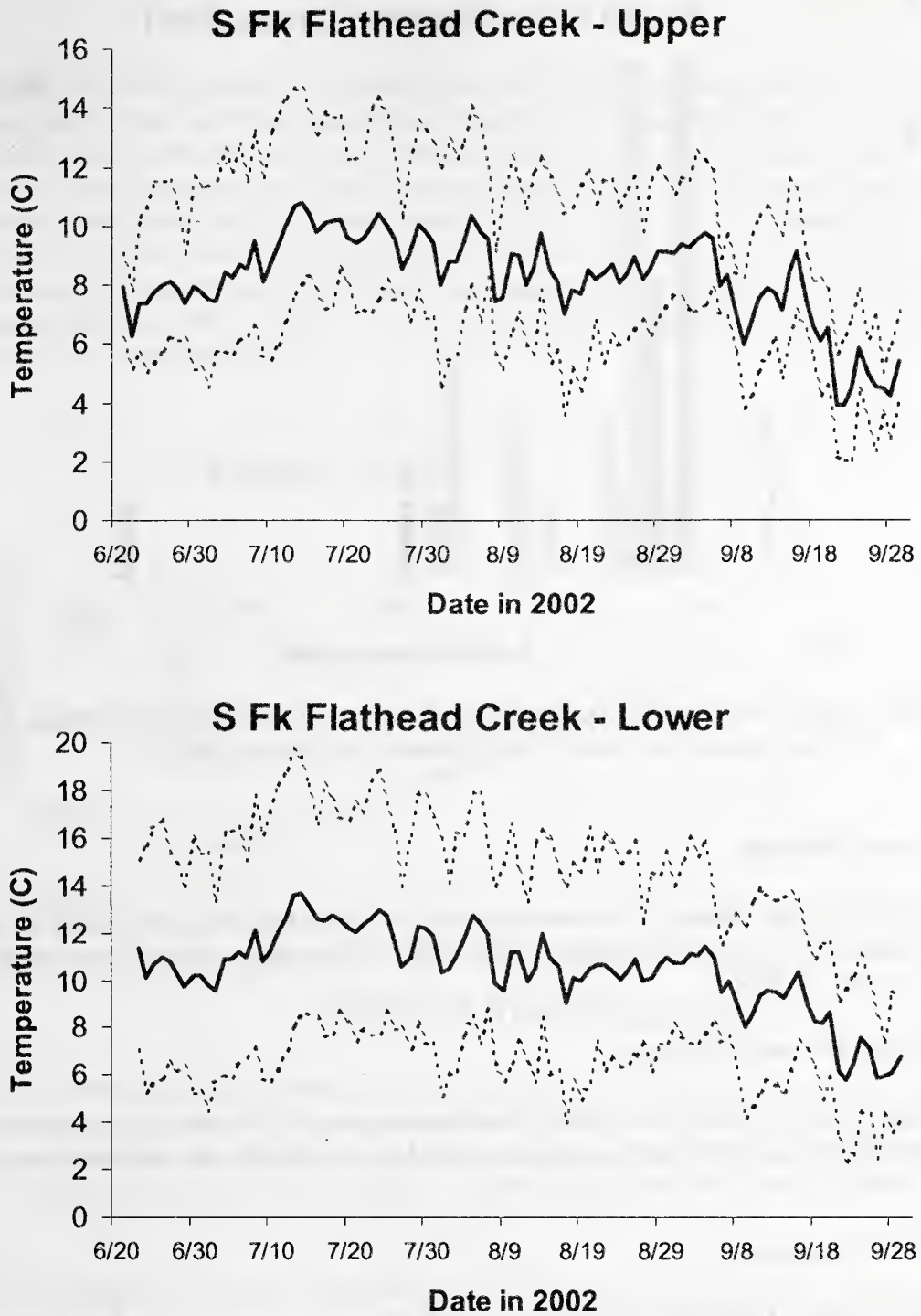

Figure 45. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in the upper portion (at km 4.2; top) and lower portion (at km 1.8; bottom) of the South Fork Flathead Creek from late-June through September 2002.

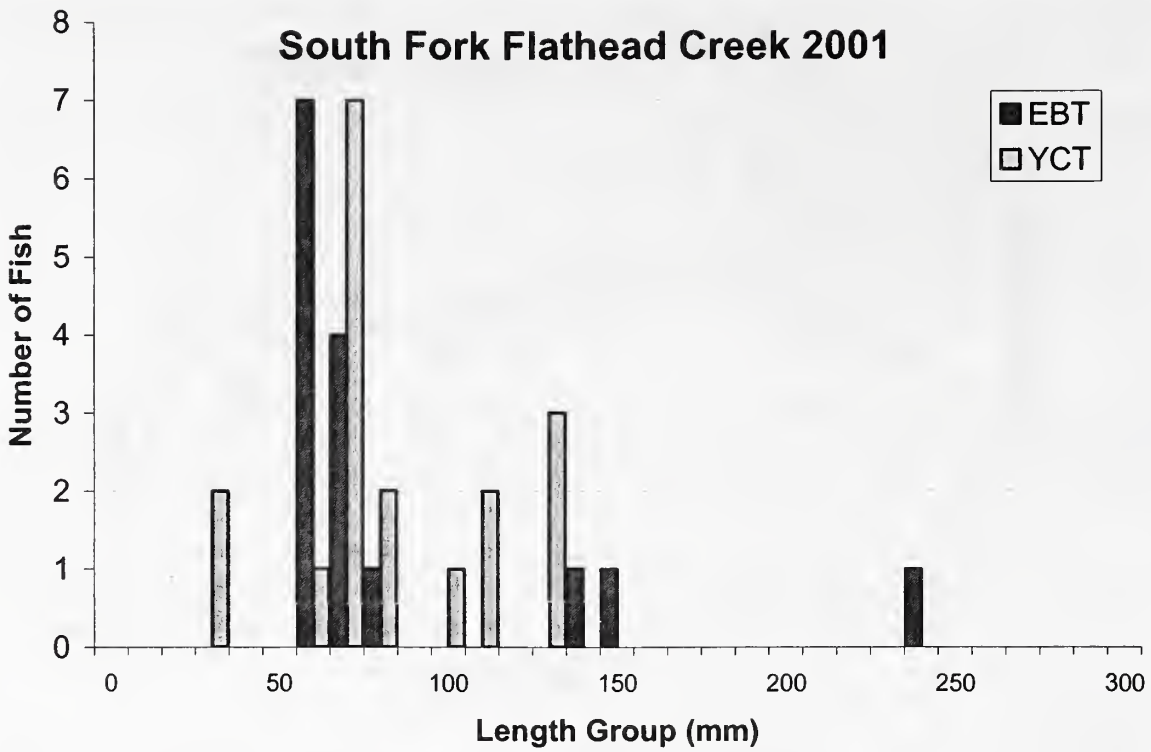

Figure 46. Length frequency histograms for Yellowstone cutthroat and brook trout captured in three sections of the South Fork Flathead Creek during 2001.

Kay Creek Drainage

Kay Creek enters the Shields River near river km 15.2 from the west. No records of any stocking into Kay Creek were found (Appendix B). No sampling was conducted in the Kay Creek drainage in 2001.

Looking Glass Creek Drainage

Looking Glass Creek enters the Shields River near river km 38.5 from the west. No records of any stocking into Looking Glass Creek were found (Appendix B). No sampling was conducted in the Looking Glass Creek drainage in 2001,

Potter Creek Drainage

According to NHD GIS hydrography Potter Creek enters the Shields River from the north just southeast of Wilsall, Montana at river km 52.8; however, the USGS 1:24,000 scale contour map (and local convention) shows Potter Creek entering main Flathead Creek above the town of Wilsall at km 5.1 (see "Flathead Creek Drainage" section above; Figure 1). Potter Creek drains over 23,500 ha and drains a relatively low gradient, high elevation, and wide valley. Potter Creek has numerous small, unnamed tributaries, but only one named tributary, Cottonwood Creek.

Potter Creek

Potter Creek has a low gradient (< 1%) throughout its 44.7 km length with a gradient of about 0.3% up to km 41, then 1.6% from km 41 to its headwaters (Figure 46). Three 1-pass fish surveys were made in Potter Creek during 2002 (Figure 46). Two other sites in upper Potter Creek were visited during mid-July 2002. At that time we found that the stream was nearly dry, with some standing water in a few pools at km 16.0, while at km 37.0 the channel was totally dry (Figure 47). Water temperatures recorded at the two lower sites during mid-July 2002 was 19°C above the mouth of Cottonwood Creek, while the water temperature below Cottonwood Creek, and Cottonwood Reservoir, was 23°C. Fish stocking records indicated Potter Creek was never stocked with fish (Appendix B).

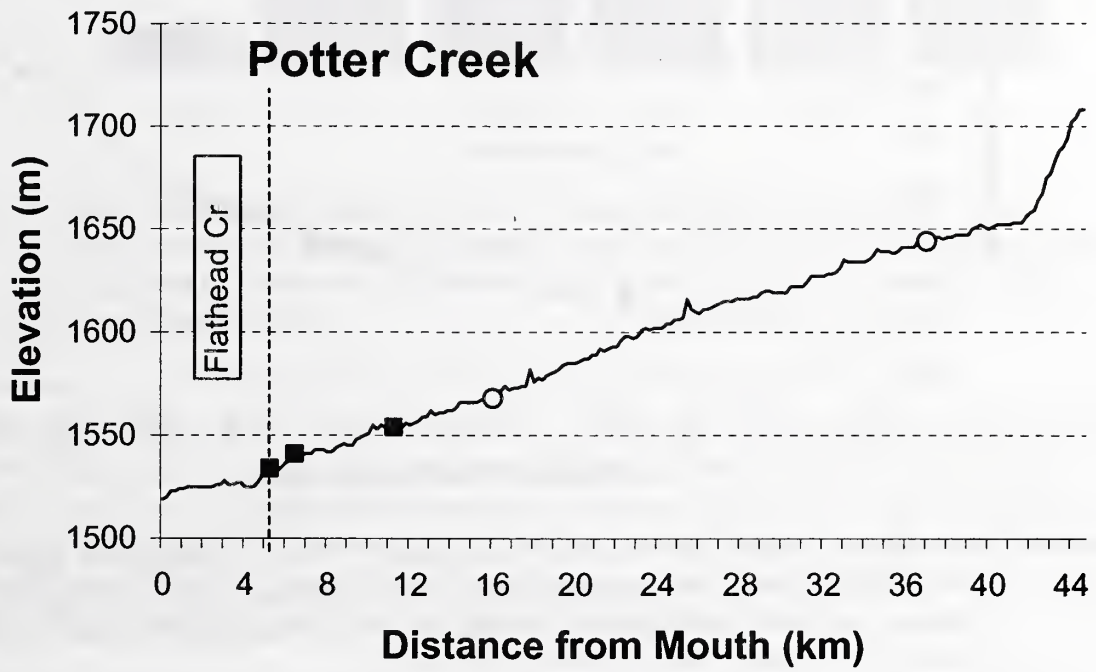

Figure 47. Elevational profile of Potter Creek showing 1-pass electrofishing sample sites (solid squares) and two locations where no flow was observed during mid-July 2002 (open circles). The mouth of Flathead Creek enters Potter Creek at approximately km 5.1 (shown by the vertical dotted line).

No trout were captured in Potter Creek at the three lower sample sites; however, white suckers, longnose suckers, longnose dace, and sculpins were found at these locations. The Potter Creek channel below Cottonwood Creek has been impacted by flows released from Cottonwood Reservoir. Most of the Potter Creek channel has little to no shade from riparian vegetation and much of streambed is covered by silt. Some evidence of livestock impacts to the channel was observed.

Cottonwood Creek (Above Wilsall, Montana)

Cottonwood Creek enters Potter Creek from the east at about stream km 9.3. Cottonwood Creek has a 96 ha irrigation reservoir located just upstream from its mouth at Potter Creek (from km 0.2 to 1.7). This reservoir typically fills during the spring and then is drained throughout the summer irrigation season. Cottonwood Creek has a relatively low gradient of less than 1% in its lower 8.9 km reach immediately above Cottonwood Reservoir, increasing to 3% in its upper 7.9 km reach (Figure 48). Five 1-pass electrofishing surveys and three depletion estimates were made in Cottonwood Creek above Cottonwood Reservoir during 2002 (Figure 48). According to a local landowner Cottonwood Creek had no flow in the vicinity of km 10 during 2001.

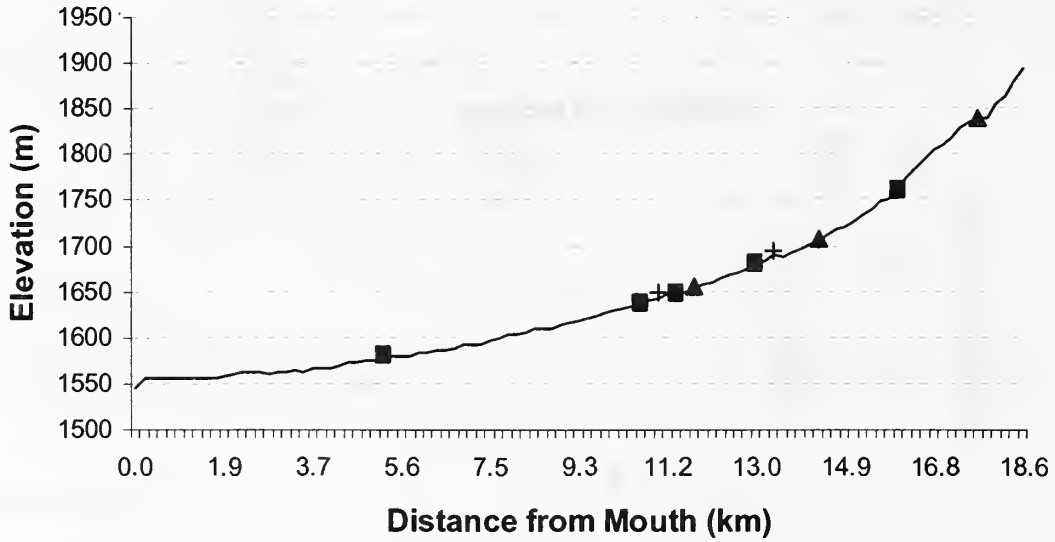

Figure 48. Elevational profile of Cottonwood Creek, above Wilsall, showing four 1-pass electrofishing sample sites (solid squares), three depletion sample sites (solid triangles), and two thermograph locations that were all sampled in 2002. Cottonwood Reservoir is located from stream km 0.25 to 1.77.

Below about stream km 11 Cottonwood Creek supported only suckers, longnose dace, and mottled sculpin. Above stream km 11 Cottonwood Creek contained only YCT and mottled sculpin (Figure 49). Since Cottonwood Creek was apparently dry near km 10 in 2001, it makes sense that YCT would be restricted above this point. Fin clips were taken from 20 YCT collected at three locations in Cottonwood Creek during 2002 (Appendix C), but these samples have not yet been analyzed (Table 1). YCT were not very abundant in any sample section, but were most abundant in the upper three sample sections (from km 14 upstream; Figure 49).

Population estimates conducted in three separate 100 m long sample sections located near stream kilometers 11.7, 14.4 and 17.6. These sections supported an estimated 6 (SE: not estimated because all fish were captured on the first pass), 11 (SE: 0.7), and 9 (SE: 0.8) YCT 75 mm and longer, respectively (Table 2; Figure 6). The estimated densities of YCT 75 mm and

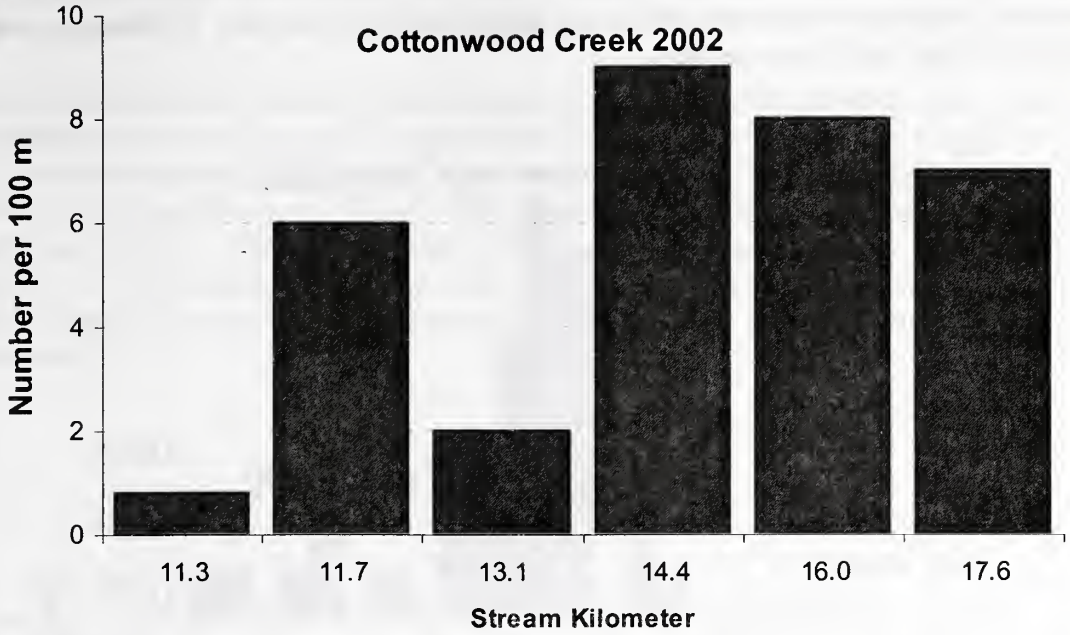

Figure 49. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) of Yellowstone cutthroat captured in six sections of Cottonwood Creek, tributary to Potter Creek, by stream kilometer captured during 2002.

longer in these sample sections were moderately low compared to other sections sampled during 2001 and 2002 (Figure 6). Average lengths of YCT ranged from 120 to 157 mm in the six sections where they were captured and there was no obvious difference in size distributions between sections though minimum and maximum lengths were slightly smaller in the upper two sample sections (Table 3). Length frequency information showed that all captured YCT were less than 250 mm, but most were less than 180 mm (Figure 50; Table 3).

Habitat surveys were conducted at km 11.7, 14.4, and 17.6. At km 11.7 the streambed of Cottonwood Creek was predominated by sand, gravels predominated at km 14.4, and silt predominated at km 17.6 (Table 4). Small and large woody debris were present at all three sample sites, but small debris was sparse at km 11.7 and 17.6 (Table 4). The frequency of large debris was relatively sparse at all three sites. Some woody debris spanned the channel at all three locations. Spawning habitat was relatively abundant at km 14.4 and rated as excellent, but was relatively rare at kilometers 11.7 and 17.6 and contained lots of silt or sands at these two locations (Table 4). At km 11.7 wetted widths averaged 2.3 m, water depth averaged 20.3 cm, pool depths averaged 33.8 cm, pool volumes averaged 6.2 m^3, and residual pool depths averaged 34 m (Table 5). At km 14.4 wetted widths averaged 2.3 m, depths averaged 14.5 cm, pool depths averaged 31.0 cm, pool volumes averaged 3.8 m^3, and residual pool depths averaged 38.8 cm. At km 17.6 wetted widths averaged 1.6 m, depths averaged 10.8 cm, pool depths averaged 18.7 cm, pool volumes averaged 0.9 m^3, residual pool depths averaged 16.7 cm. Instream cover was relatively high in all three sections and was formed primarily by woody debris in all three sections with substrate contributing to instream cover at km 11.7 and 17.6 (Table 6). Bank cover

and pool quality were rated as high at km 11.7 and 14.4, but was only moderate at km 17.6. Alder and willow provided most bank cover in the lower two sections. Riparian use was moderate to high in all three sections.

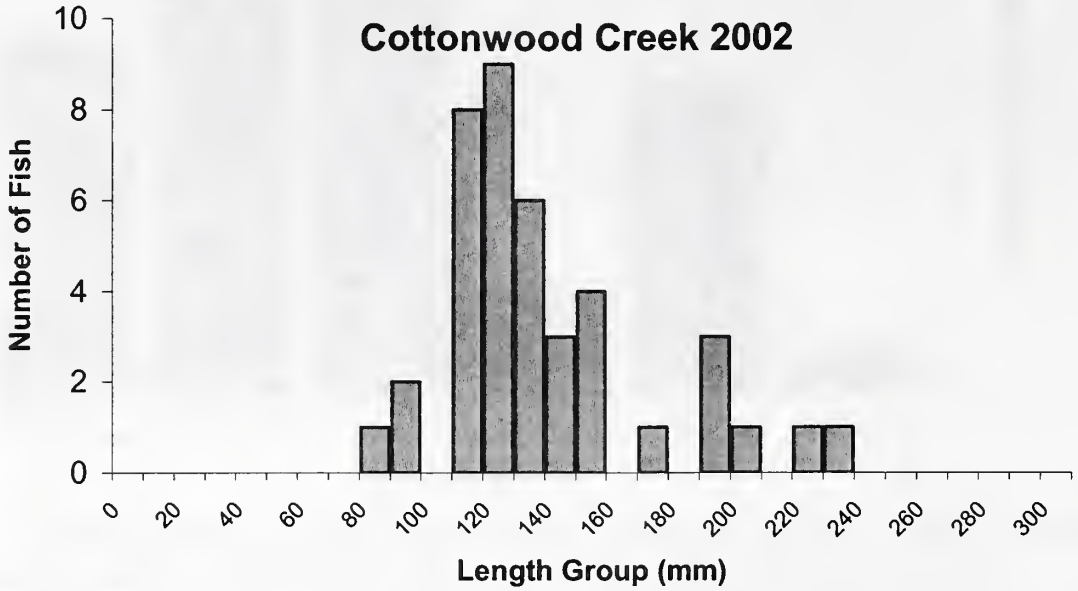

Figure 50. Length frequency histogram for Yellowstone cutthroat trout captured in six sections of Cottonwood Creek, tributary to Potter Creek, during 2002.

Willow Creek Drainage

Willow Creek drains approximately 8,000 ha and enters the Shields near river km 14.8, below the town of Clyde Park, Montana (Figure 1). Three headwater forks flow into Willow Creek with the South and Middle forks forming Willow Creek approximately 12.4 km above its mouth at the Shields River. The South Fork of Willow Creek is designated as Willow Creek on some maps and South Fork Willow Creek on others. While I term this portion of Willow Creek the South Fork, it is shown on 1:100,000 USGS maps as Willow Creek and appears that way on NHD hydrography coverages used in GIS applications. The North Fork of Willow Creek enters Willow Creek about 3.8 km below the junction of the Middle and South forks (at about km 8.6). The lower 11.3 km of Willow Creek flows through the Shield-Smith Valleys level IV ecoregion and its upper 1.1 km flows through the ecoregion (Figure 1; Woods et al. 1999; Appendix A). The lower portions of the forks also flow through the Non-calcareous Foothill Grassland ecoregion and the upper portions flow through the Absaroka-Gallatin Volcanic Mountains ecoregion (Figure 1; Woods et al. 1999; Appendix A).

Willow Creek

Willow Creek has a low gradient (< 2%) throughout its 12.4 km length where both 1-pass electrofishing survey sections were located during 2001 (Figure 51). Willow Creek was stocked with 20,000 undesignated (likely YCT) cutthroat trout fry and 1,590 undesignated (likely YCT) cutthroat trout fingerlings from 1939 to 1944 (Appendix B). Average daily water temperatures ranged from 12 to 19°C during the summer of 2002 and were above 15°C for most of July (Figure 52). Willow Creek, as its name would suggest, was dominated by willow stands along most of its length. Numerous beaver dams and complexes were observed between the North and Middle forks.

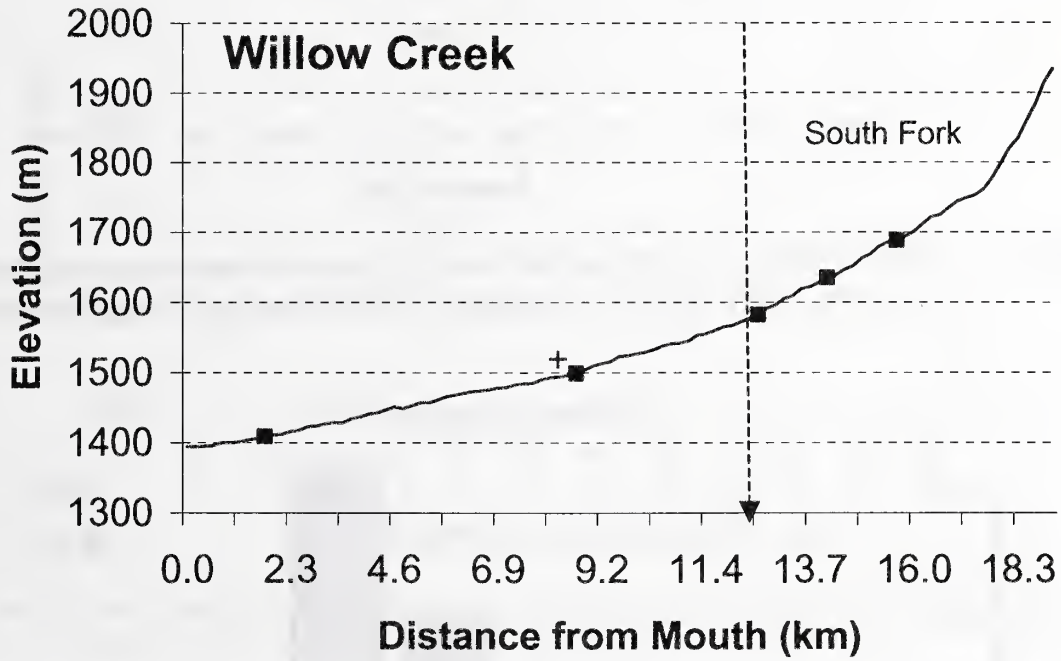

Figure 51. Elevation profile of Willow Creek channel showing locations of 1-pass (solid squares) fish sampling sections and thermographs during 2002 (+). The South Fork of Willow Creek enters Willow Creek at km 12.4 (dotted vertical line) and the upper 6.7 km of this profile represents the South Fork of Willow Creek.

Only brown trout and suckers were captured in main Willow Creek, but sampling was inefficient due to beaver ponds. Below the North Fork (at km 8.6) no fish were captured, but it is likely that fish inhabited the numerous beaver ponds located in this portion of the stream. Brown trout were present in the upper sample site and their relative abundance was relatively low at this site (Figure 53). The five brown trout captured in Willow Creek averaged 199 mm in length (range: 180-220), while white suckers averaged 253 mm and longnose suckers averaged 96 mm (Table 3). No habitat surveys were conducted in main Willow Creek.

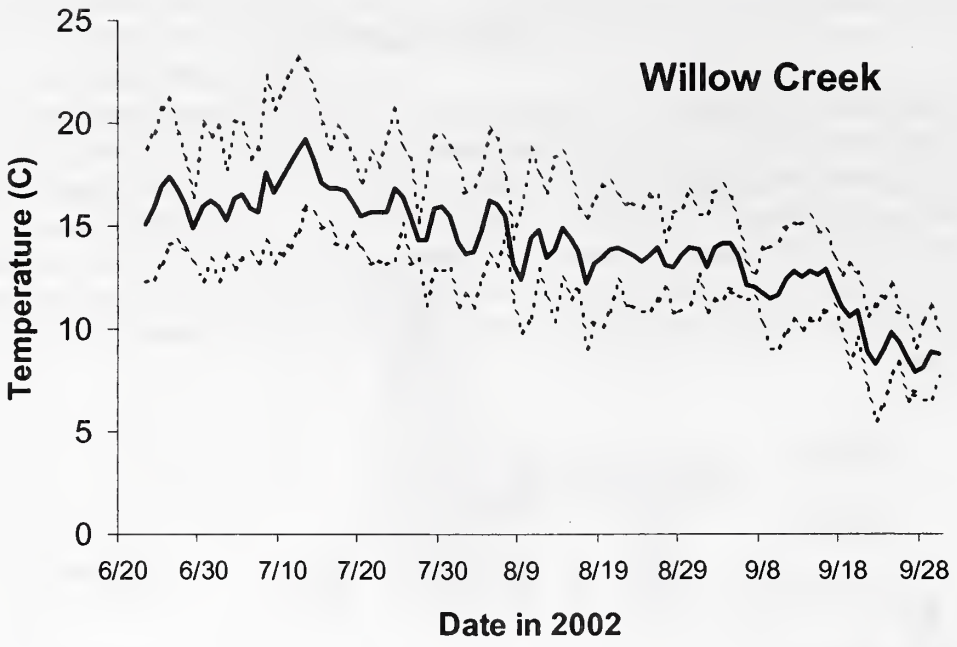

Figure 52. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in Willow Creek near km 8.5 during late-June through September 2002.

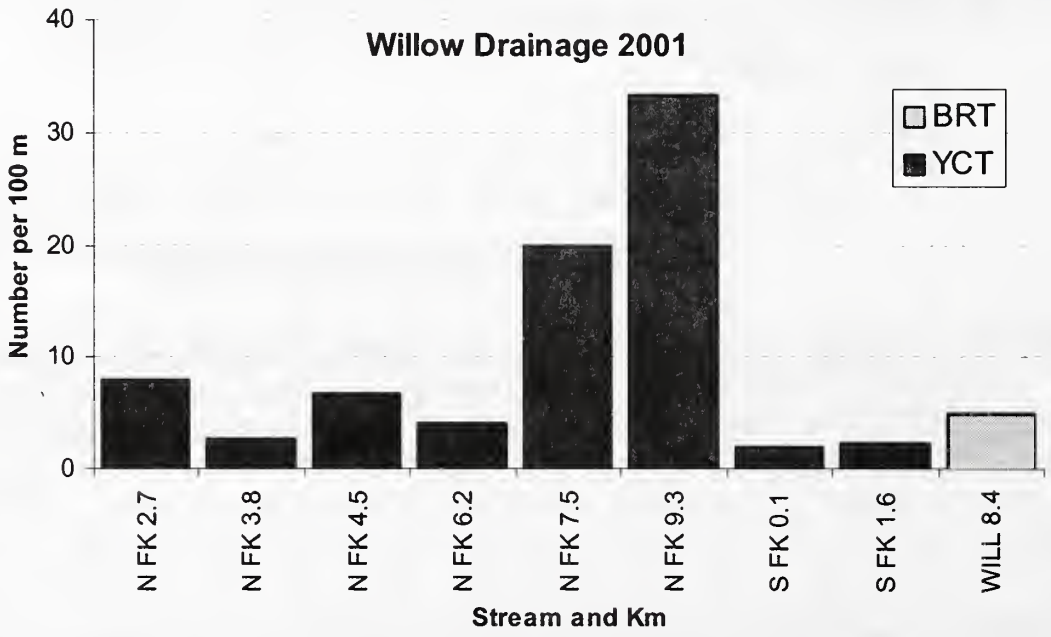

Figure 53. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) of Yellowstone cutthroat (YCT) and brown (BRT) trout captured in six sections of the North Fork (N FK), two sections of the South Fork (S FK), one section in main Willow Creek (WILL) during 2001 by stream kilometer.

Middle Fork Willow Creek

The Middle Fork of Willow Creek has a moderate gradient (4.6%) in its lower 7.6 km, where two 1-pass electrofishing survey sections were located during 2001, increasing to over 14% from km 7.6 to its headwaters at km 9.8 (Figure 54). No records of any stocking into the Middle Fork of Willow Creek were found (Appendix B). No fish were captured or observed in either of the two sample sections. No amphibians were observed.

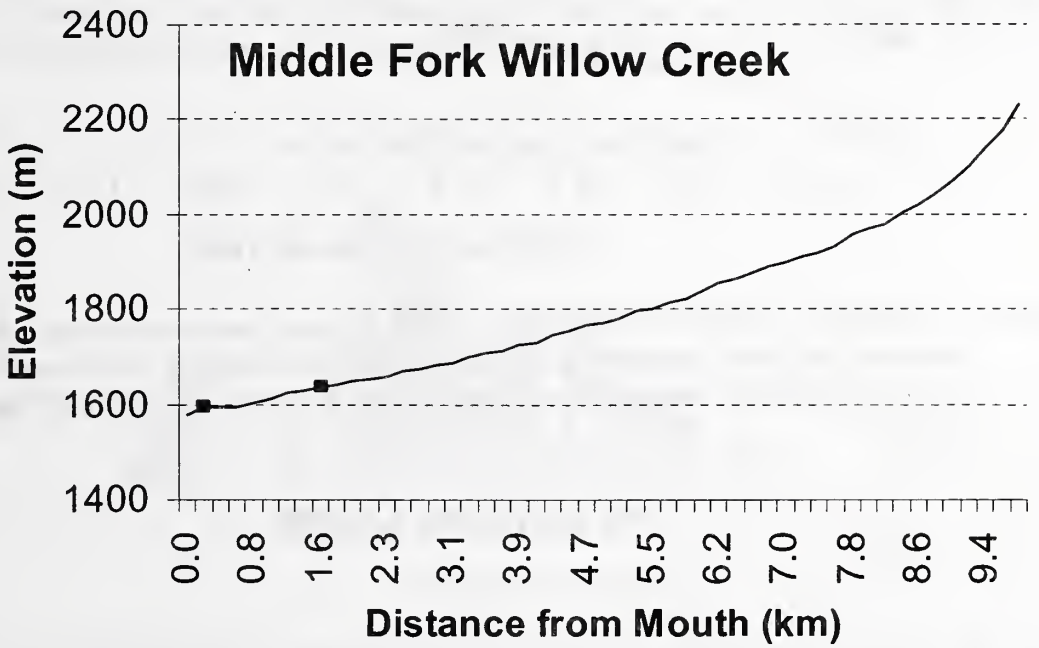

Figure 54. Elevation profile of the Middle Fork of Willow Creek channel showing locations of two 1-pass (solid squares) fish sampling sections.

North Fork Willow Creek

The North Fork of Willow Creek has a moderately low gradient (3.4%) in its lower 13.8 km where all five 1-pass electrofishing survey sections and both fish population estimate sample sections were located during 2001, increasing to over 15% from km 13.8 to its headwaters at km 15.5 (Figure 55). Average daily water temperatures ranged from 12 to 19°C during the summer of 2002 and were above 15°C for most of July (Figure 56). The North Fork of Willow Creek was stocked with 3,680 undesignated (likely YCT) cutthroat trout fingerlings in 1941 (Appendix B).

The North Fork of Willow Creek supported Yellowstone cutthroat trout and mottled sculpin. Genetic testing of 17 YCT collected from the North Fork Willow Creek during 1993 did not find any evidence of introgression (Appendix D). Fin clips were taken from 22 YCT collected at six sites in the North Fork of Willow Creek during 2001 to further test for potential introgression

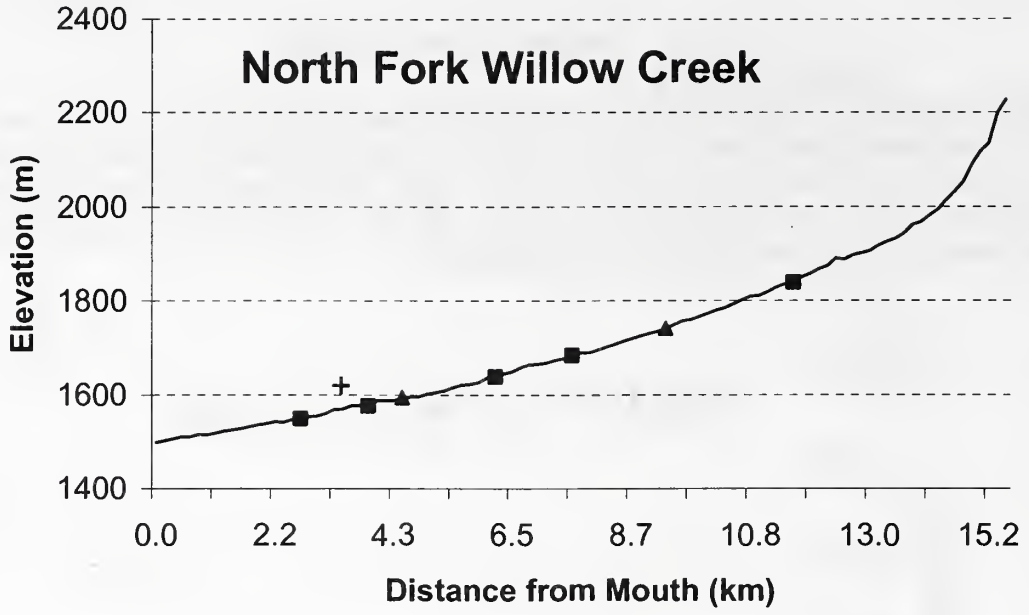

Figure 55. Elevation profile of the North Fork of Willow Creek channel showing 1-pass (solid squares) and depletion estimate (solid triangles) fish sampling sections and location of a thermograph that recorded water temperatures from mid-June through September 2002.

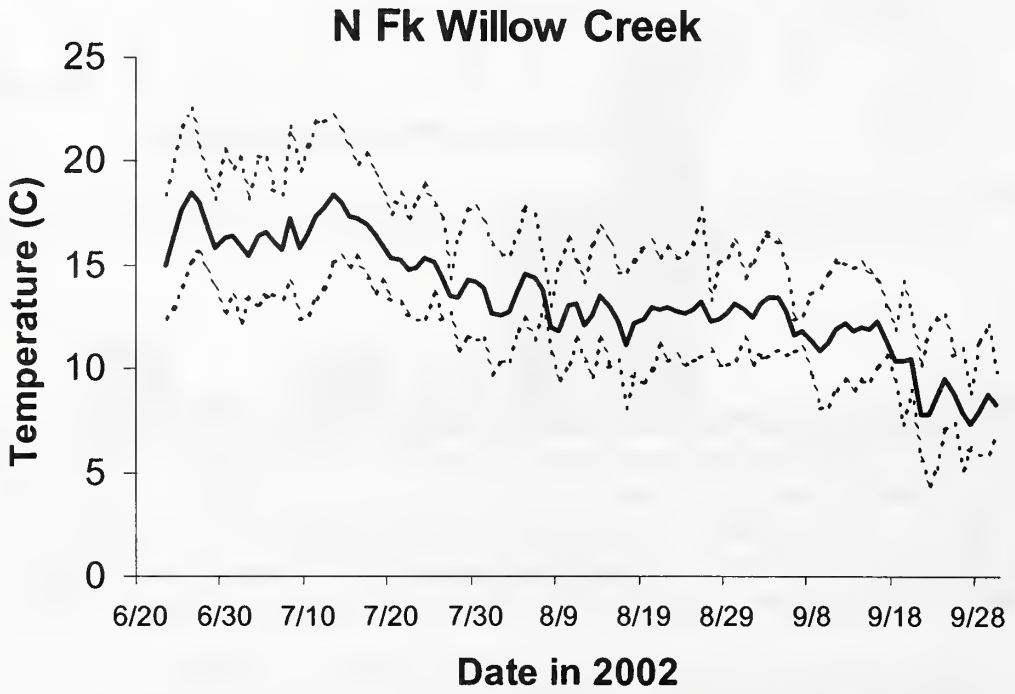

Figure 56. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in the North Fork of Willow Creek near km 2.9 during late-June through September 2002.

(Appendix C). Nineteen of these fish were successfully analyzed and no evidence of introgression was observed (Table 1). YCT were extremely abundant in the upper two sample sections, but their abundance declined dramatically from km 6.2 downstream (Figure 53).

Population estimates were made in two sample sections within the North Fork. The lower 75 m long sample section (near km 4.5) supported an estimated 5 (SE could not be estimated because all fish captured on first pass) YCT 75 mm and longer (Table 2). The upper 75 m long sample section (near km 9.3) supported an estimated 29 (SE: 0.8) YCT 75 mm and longer, one of the higher densities of YCT we found in our sampling (Table 2; Figure 6). YCT averaged from 115 mm, at the uppermost sample site, to 189 mm in length (Table 3). A length frequency histogram for all YCT captured in the North Fork of Willow Creek illustrated that some young-of-the-year fish (<50 mm) were captured, but most captured fish were between 100 and 200 mm (Figure 57).

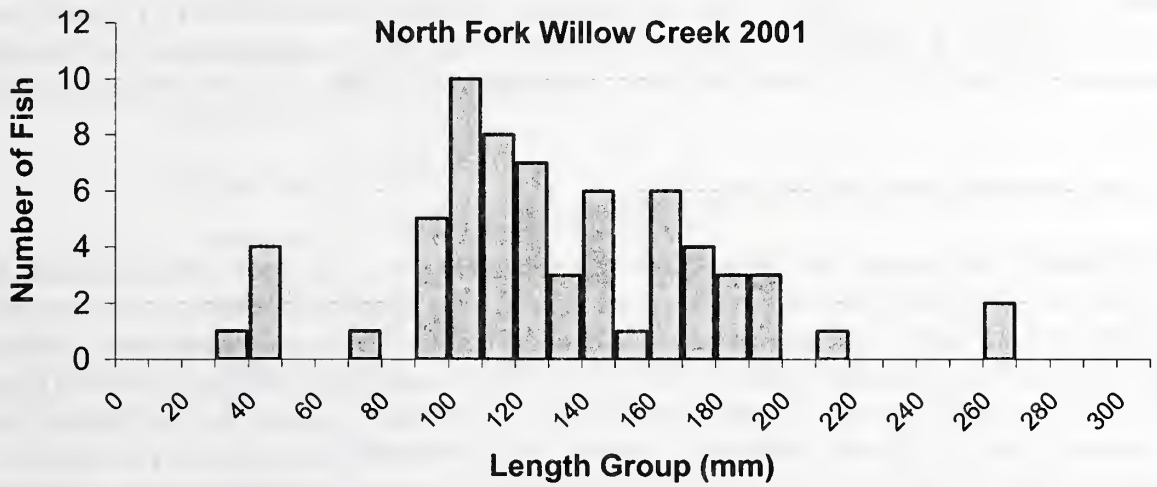

Figure 57. Length frequency histogram for Yellowstone cutthroat trout captured in six sections of the North Fork of Willow Creek during 2001.

Habitat surveys conducted at km 4.5 found that the streambed was predominated by silt; while at km 9.3 small gravel, large gravel, and silt were equally abundant (Table 4). Woody debris was very abundant in both sections, but more of this debris crossed the wetted channel in the upper section (Table 4). Spawning habitat was extremely limited in the lower habitat section (km 4.5) and moderately low in the upper section (Table 4). Spawning gravels in both sections contained lots of silt that reduced its quality. The stream channel was smaller, average wetted width of 1.9 m and average depth of 7.6 cm, at km 4.5 than at km 9.3, where the average width was 2.5 m and average depth was 9.2 cm (Table 5). Rankings of cover, bank stability, and pool quality were lower at the lower habitat section (km 4.5) than at the upper section (km 9.3), while riparian use was moderately high in both sections (Table 6). Domestic livestock accounted for most of the riparian use in the lower section, while logging-related use in the upper basin appeared to cause channel impacts at the upper habitat site.

South Fork Willow Creek

The gradient of the lower 5.1 km of the South Fork of Willow Creek is just over 3%, increasing to over 11% from km 5.1 to its headwaters at km 6.7 (Figure 51). Three sections were sampled in the lower 3.2 km of the South Fork. The South Fork of Willow Creek was stocked with 3,1520 undesignated (likely YCT) cutthroat trout fingerlings in 1946 (Appendix B). Beaver activity was evident in the lower portion of the South Fork. The stream became very small at km 3.2 and no fish were seen or captured at this location.

The South Fork of Willow Creek supported Yellowstone cutthroat trout and mottled sculpin. Spotted frogs were also seen at the lower section (km 0.2). Fin clips were collected for genetic analysis from all three YCT captured in 2001 (Appendix C) and no introgression was detected (Table 1); however, the extremely low sample size makes it difficult to conclude with certainty that no introgression occurred within this population. Relative abundances of YCT were very low (Figure 53). A small beaver pond was included within the sample section at the lowermost sample site (km 0.2). Only three YCT were captured and all these fish were over 150 mm (Table 3).

Change in Fish Communities Over Time

Estimates of fish populations during 2003 were relatively precise for most sections (Table 2 and Figure 58). Since estimates of trout were not too different above and below culvert locations (Figure 59), estimates were pooled across above and below culvert sample sections. Relative abundances of trout declined from the 1970's to 2003 in many of the sampled sections (Figure 59, top). It should be noted that the extremely high abundances reported for the Middle Fork Brackett Creek in 1989 and 1990 were related to the fact that only high quality pool habitats were sampled at that time (Lohr 1993). The proportion of brook trout increased in eight of the sample sections and brook trout appeared to have recently invaded three sections: Bennett Creek, Mill Creek, and middle Brackett Creek (Figure 58 and bottom of Figure 59). The proportion of brown trout appeared to increase in four sections and they appeared to have recently invaded Mill Creek. Where several years of data are available, it appears that where brook trout occur, they have been increasing over time. Exceptions to this observation were found in Rock Creek, where it appears the increasing populations of brown trout might be displacing brook trout. The proportion of rainbow trout appears to be declining in the two Cottonwood Creek sections where they were found in earlier surveys. While Berg (1975) had found YCT in lower Horse Creek in 1974, no trout at all were found in this location in 2003.

Discussion

Current Fish and Frog Distributions

Current distributions of fish in Shields River tributaries illustrate that YCT are distributed throughout much of the basin (Figure 60) and genetically sampled YCT populations had no or little evidence of introgression (hybridization) with rainbow trout (Figure 61). No YCT populations that were genetically tested exhibited more than eight percent introgression with

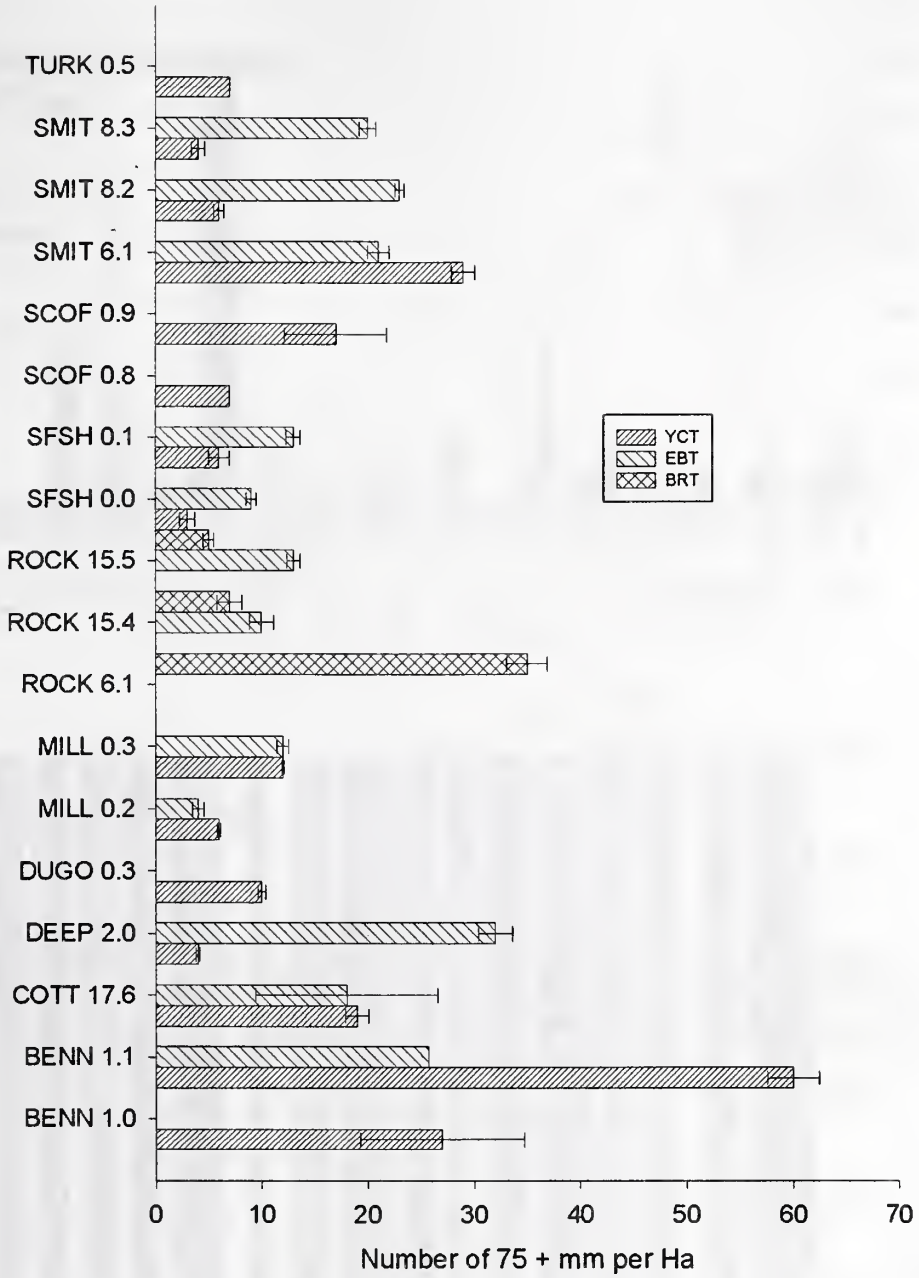

Figure 58. Estimated numbers of Yellowstone cutthroat trout (YCT), brook trout (EBT), and brown trout (BRT) per hectare of stream surface area during 2003 in sections of Bennett (BENN), Cottonwood (COTT; east of Clyde Park, MT), Deep (DEEP), Dugout (DUGO), Mill (MILL), Rock (ROCK), Scofield (SCOF), Smith (SMIT), and Turkey (TURK) creeks and South Fork Shields River (SFSH) by stream kilometer (shown after abbreviation). Standard errors are shown as lines around the bars.

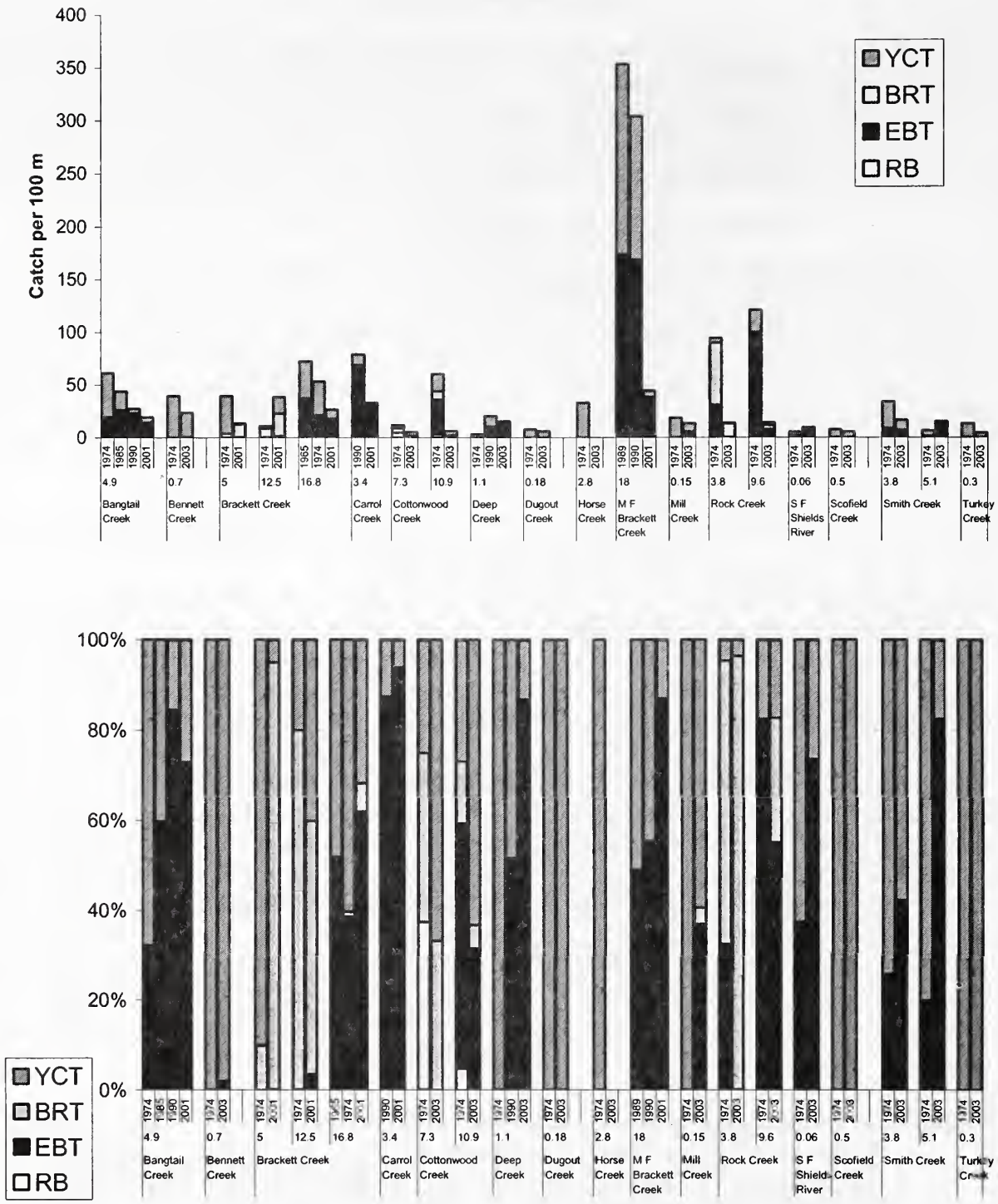

Figure 59. Catch per 100 m of stream length (top) and proportions (bottom) by species for various sections sampled in selected tributaries to the Shields River by stream mile and year showing changes in fish community composition through time. Catches in the Middle Fork Brackett Creek for 1989 and 1990 represent only pool habitats.

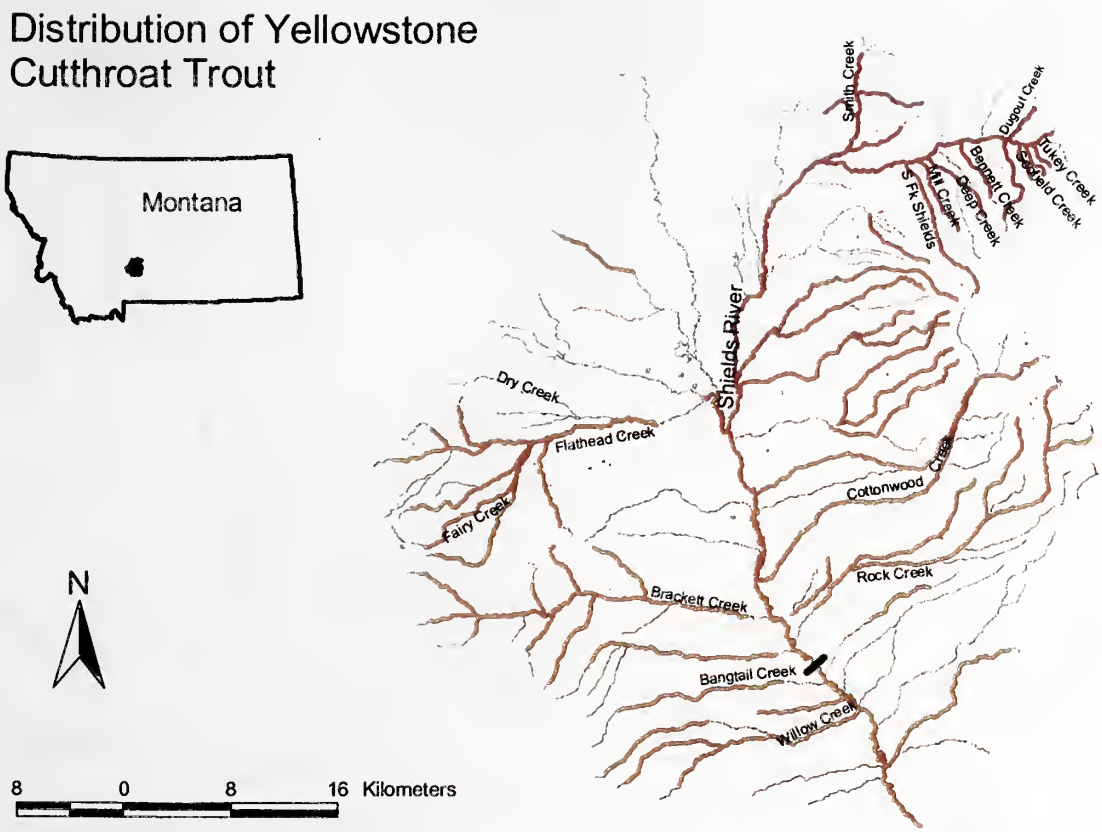

Figure 60. Map of the Shields River drainage showing the current (2003) distribution of Yellowstone cutthroat trout. The broad black bar across the lower Shields River shows the location of the Chadborne irrigation diversion that is a partial barrier to upstream fish movement.

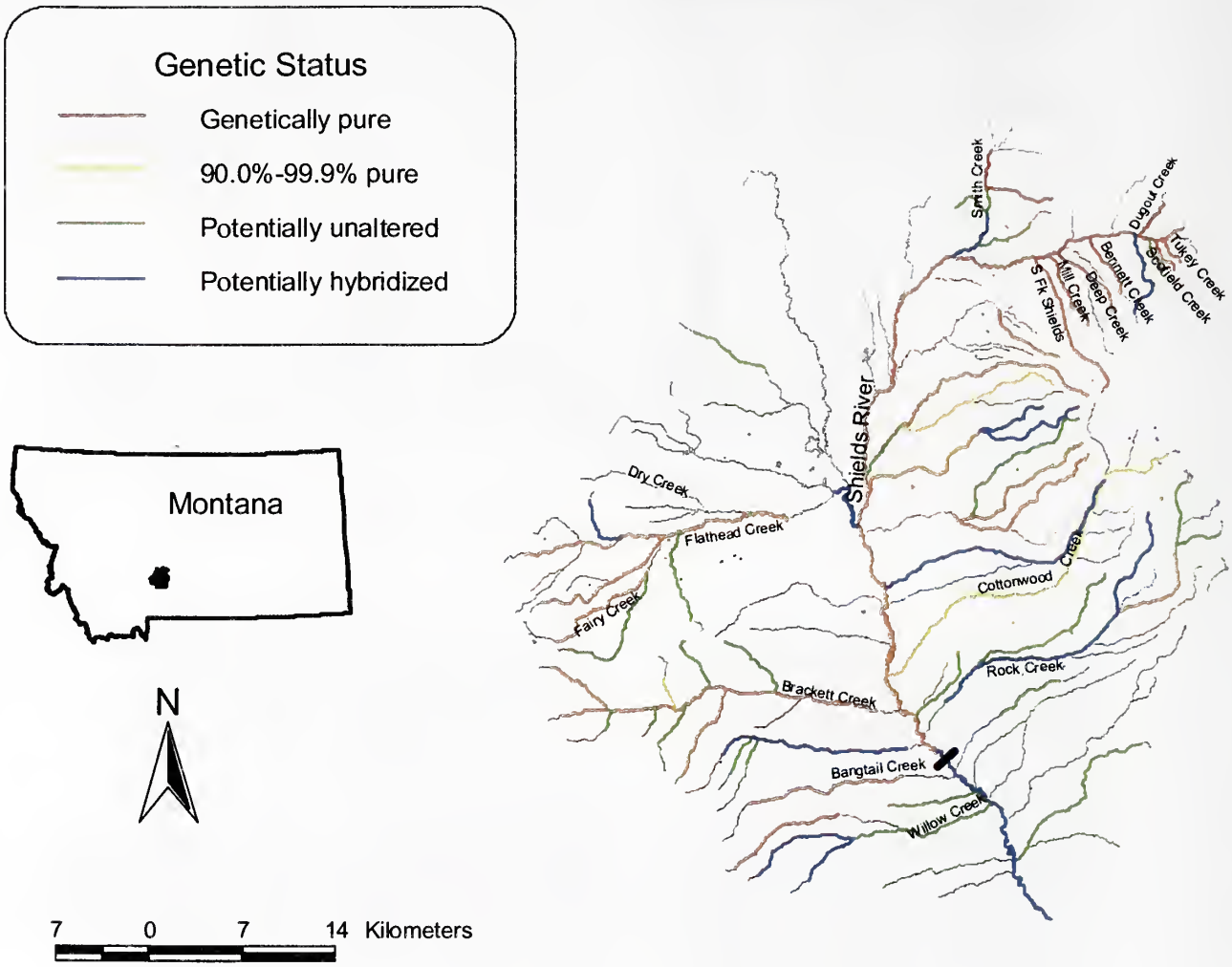

Figure 61. Map of the Shields River drainage showing the current (2003) genetic status of Yellowstone cutthroat trout. The broad black bar across the lower Shields River shows the location of the Chadborne irrigation diversion that is a partial barrier to upstream fish movement.

rainbow trout (Table 1 and Appendix D). Rainbow trout were primarily restricted to the lower portions of the Shields River and Cottonwood and Brackett creeks (Figure 62). Rainbow trout were stocked into Brackett, Cottonwood, and Daisy Dean creeks and the Shields River (Appendix B); however all stocking of streams and rivers in the Shields drainage ended in the early 1970's. Rainbow trout can probably access the Shields River from lower source populations, particularly from the Yellowstone River, but the Chadborne irrigation diversion has

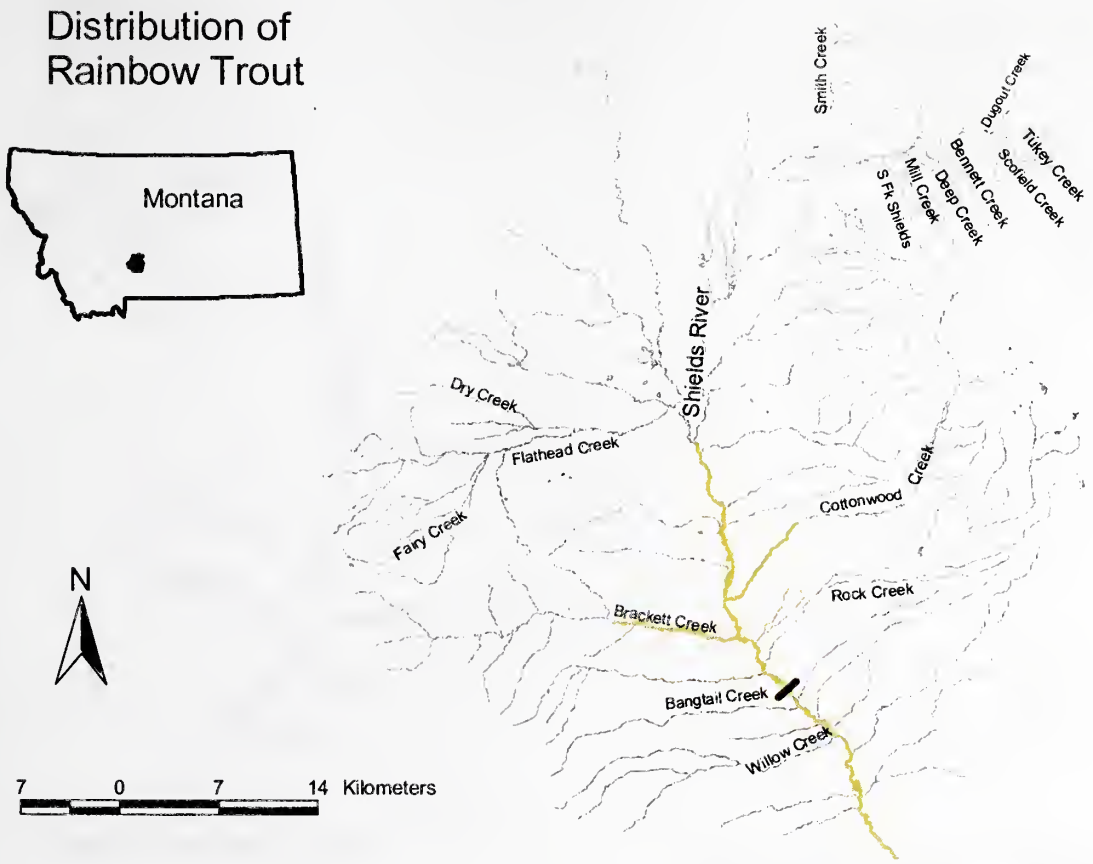

Figure 62. Map of the Shields River drainage showing the current (2003) distribution of rainbow trout. The broad black bar across the lower Shields River shows the location of the Chadborne irrigation diversion that is a partial barrier to upstream fish movement.

probably limited the ability of rainbow trout to invade the upper Shields drainage. This diversion crosses the entire lower Shields River (Figure 61) and was believed to function as a nearly total barrier to upstream fish movement until relatively recently (within the past ten years) when a portion of this diversion was broken down by ice and high flows. Genetic testing of fish collected from the Shields River near Clyde Park, Montana in 1999 found several fish that were identified as first generation hybrids between rainbow and Yellowstone cutthroat trout (Appendix D and personal communication, R. Leary, Wild Salmon and Trout Genetic Laboratory, University of Montana, Missoula, Montana).

Brown trout are widely distributed throughout the Shields River and the lower portions of most of its tributaries (Figure 63). They also extend relatively high into the Rock, Brackett, Bangtail, Cottonwood, and Flathead drainages. Brook trout were found in the upper portions of the

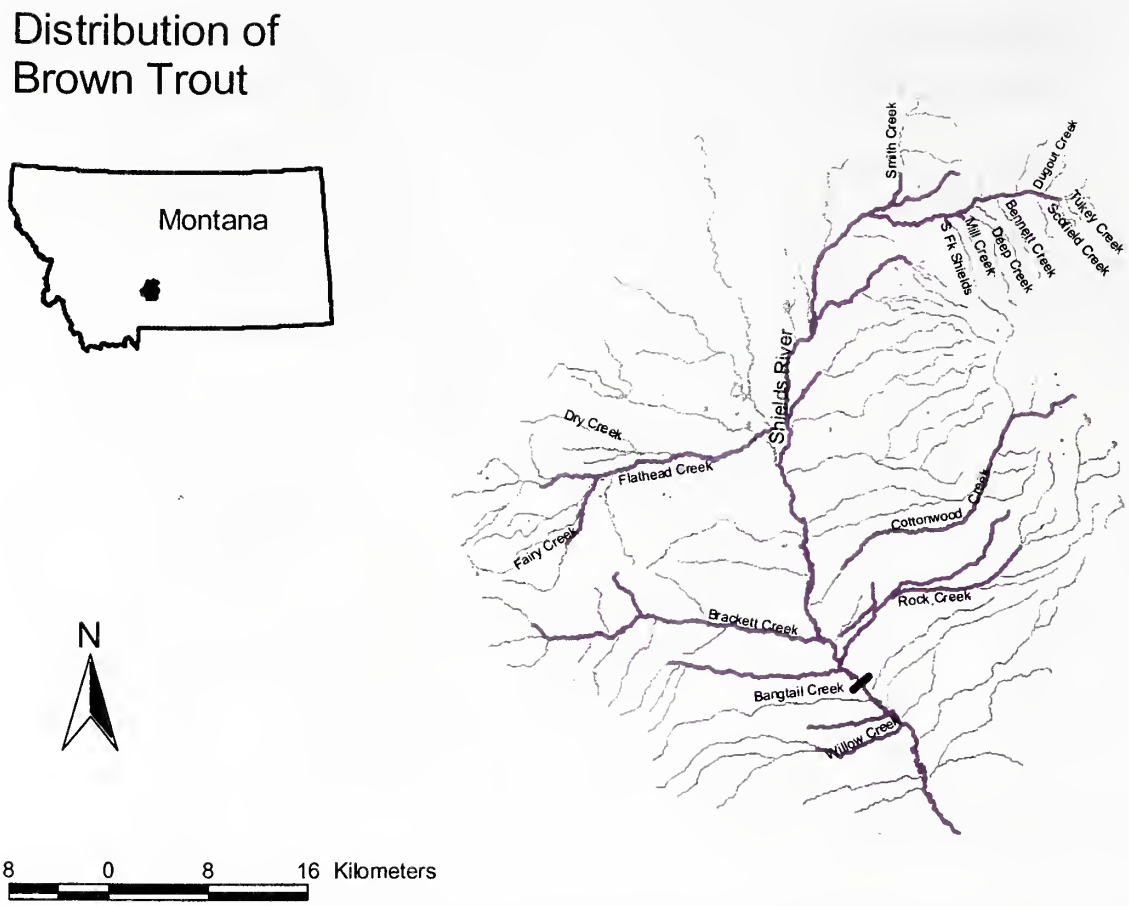

Figure 63. Map of the Shields River drainage showing the current (2003) distribution of brown trout. The broad black bar across the lower Shields River shows the location of the Chadborne irrigation diversion that is a partial barrier to upstream fish movement.

Canyon, Brackett, and Flathead Creek drainages, throughout the Bangtail, Rock, Cottonwood, and Horse Creek drainages, and through much of the upper Shields River above Wilsall, Montana, and in several headwater tributaries (Figure 64). Distributions of brook trout and YCT overlapped considerably. Mottled sculpins were found throughout most of the drainage, but their distribution appeared to be restricted from the highest elevations (Figure 65).

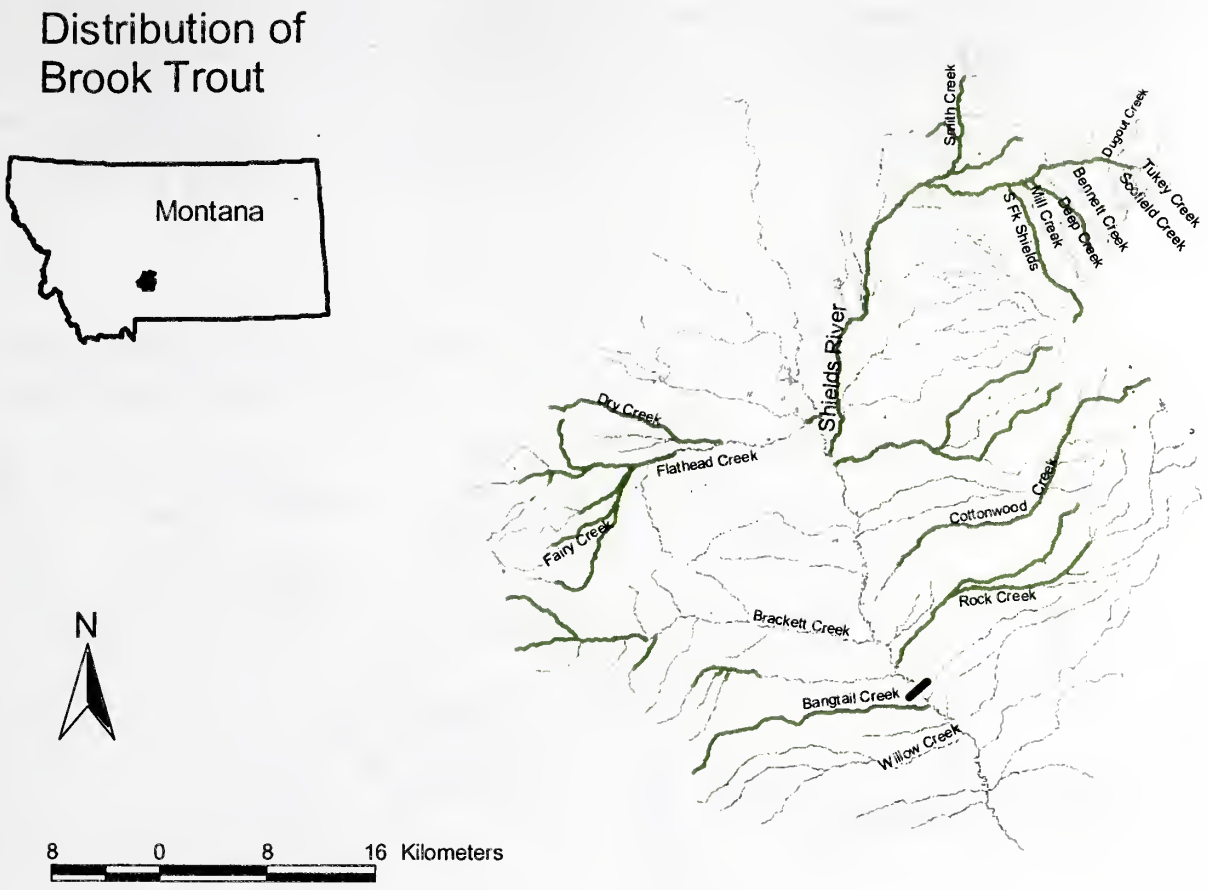

Figure 64. Map of the Shields River drainage showing the current (2003) distribution of brook trout. The broad black bar across the lower Shields River shows the location of the Chadborne irrigation diversion that is a partial barrier to upstream fish movement.

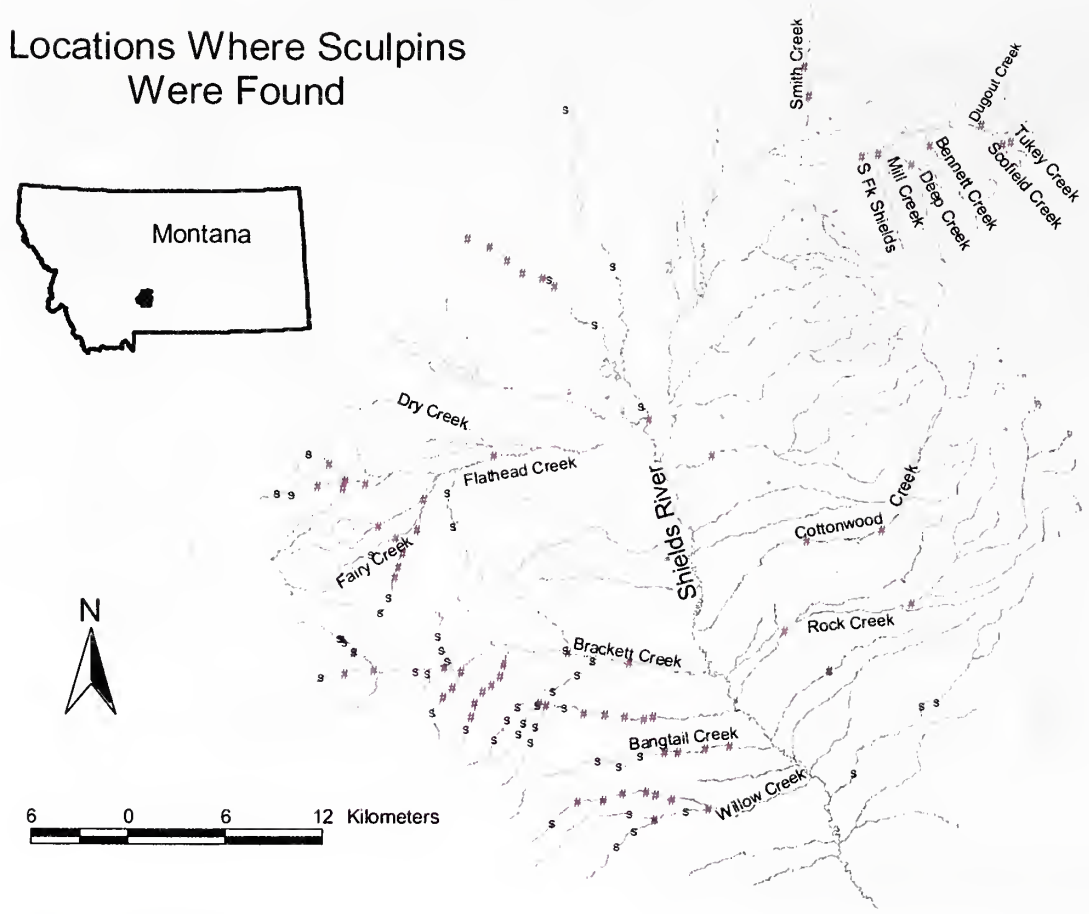

Figure 65. Map of the Shields River drainage showing locations (2001-2003) where sculpin were found. Closed circles indicate sculpins were observed and open circles indicated a site was sampled, but no sculpin were seen.

Suckers were found in the lower portions of Willow Creek, Brackett Creek, Cottonwood Creek (above Wilsall, Montana), Potter Creek, Horse Creek, and Chicken Creek (Figure 66). Longnose dace were restricted to Cottonwood Creek (above Wilsall, Montana), lower Potter Creek, and lower Chicken Creek. The reservoir on Cottonwood Creek (above Wilsall, Montana) provides good habitat for suckers and dace and they are abundant above and below the reservoir. Lake chub were found in Flathead Creek near km 13.6.

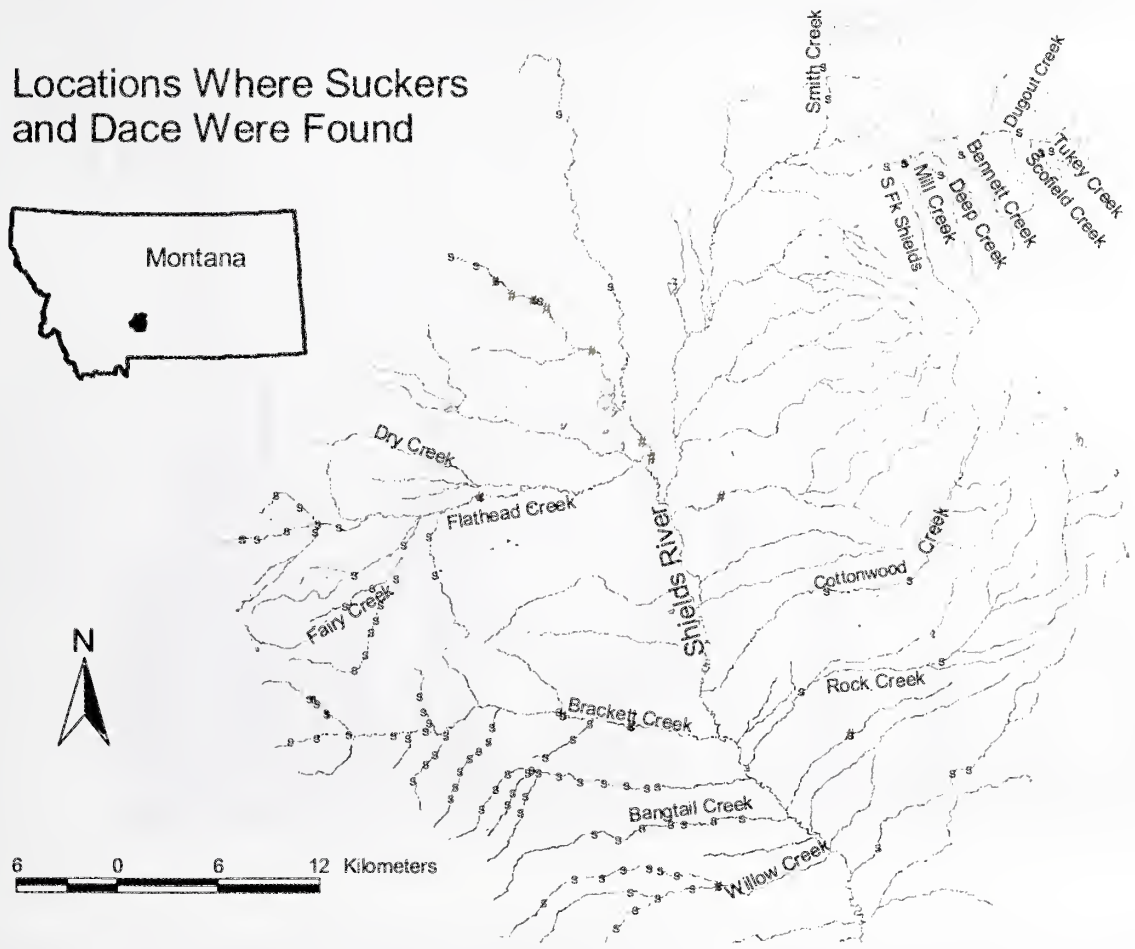

Figure 66. Map of the Shields River drainage showing locations (2001-2003) where suckers (longnose and/or white suckers) and dace were found. Closed circles indicate suckers were observed and open circles indicated a site was sampled, but no suckers were seen.

Both spotted and leopard frogs were seen in the Shields drainage (Figure 67). Spotted frogs were seen in the Willow Creek, upper Flathead Creek, and Falls Creek drainages, while leopard frogs were seen in the upper Brackett and lower Dugout Creek drainages.

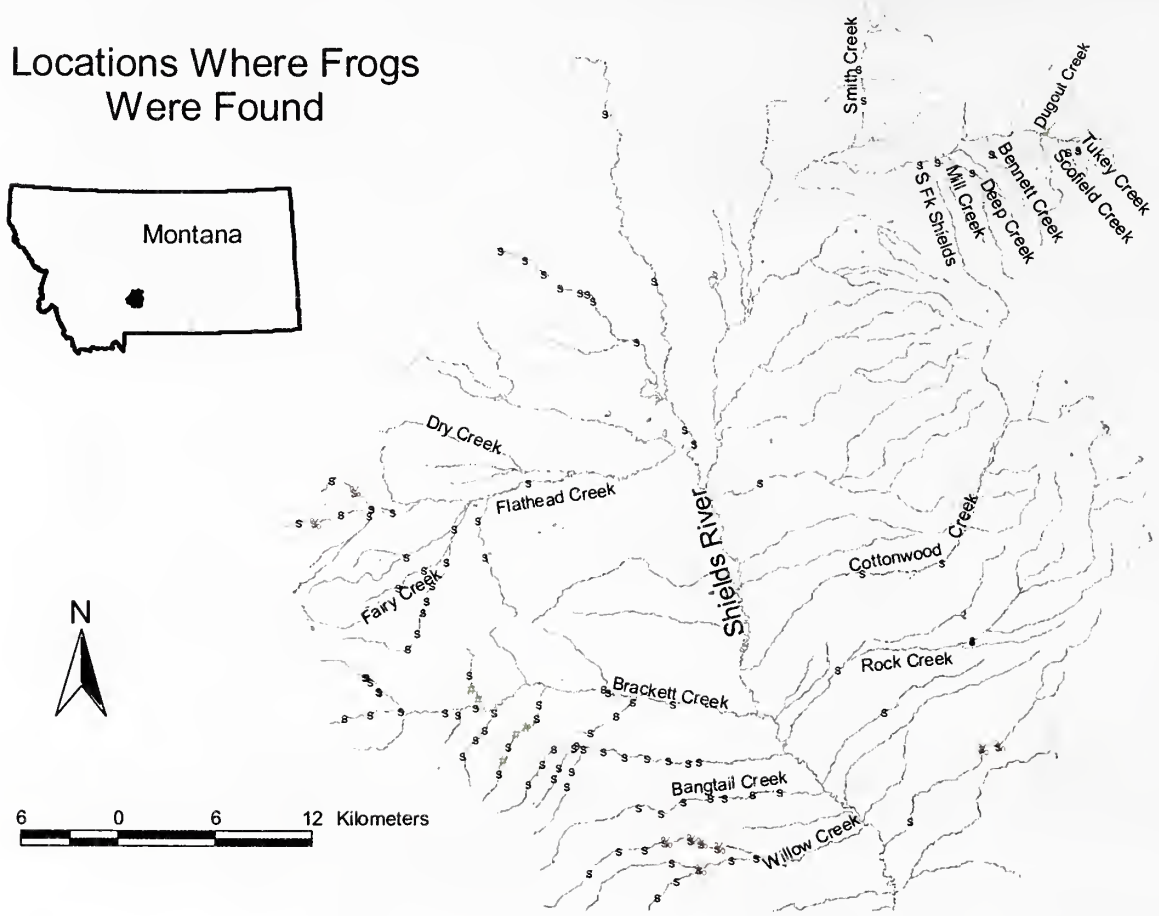

Figure 67. Map of the Shields River drainage showing locations (2001-2003) where spotted (solid squares) and leopard (filled circles) frogs were found. Open circles indicated a site was sampled, but no frogs were seen.

Abundance of Trout

Relative abundances of trout (number of trout 75 mm and longer captured in the first electrofishing pass standardized to number per 100 m of stream length) ranged from a low of about 0.5 trout per 100 m up to slightly over 52 trout per 100 m (Figure 68). YCT abundances ranged from 0 to over 39 per 100 m for all sections sampled and from 0.6 to over 33 per 100 m for those sections where YCT existed in allopatry. When relative abundances of YCT in Shields River tributaries were compared to over 1,400 sections where cutthroat trout (both Yellowstone and westslope) have been sampled in Montana during the past 15 years, abundances of YCT in the Shields River tributaries appear to be relatively low compared to the distribution of abundances across Montana (Figure 69).

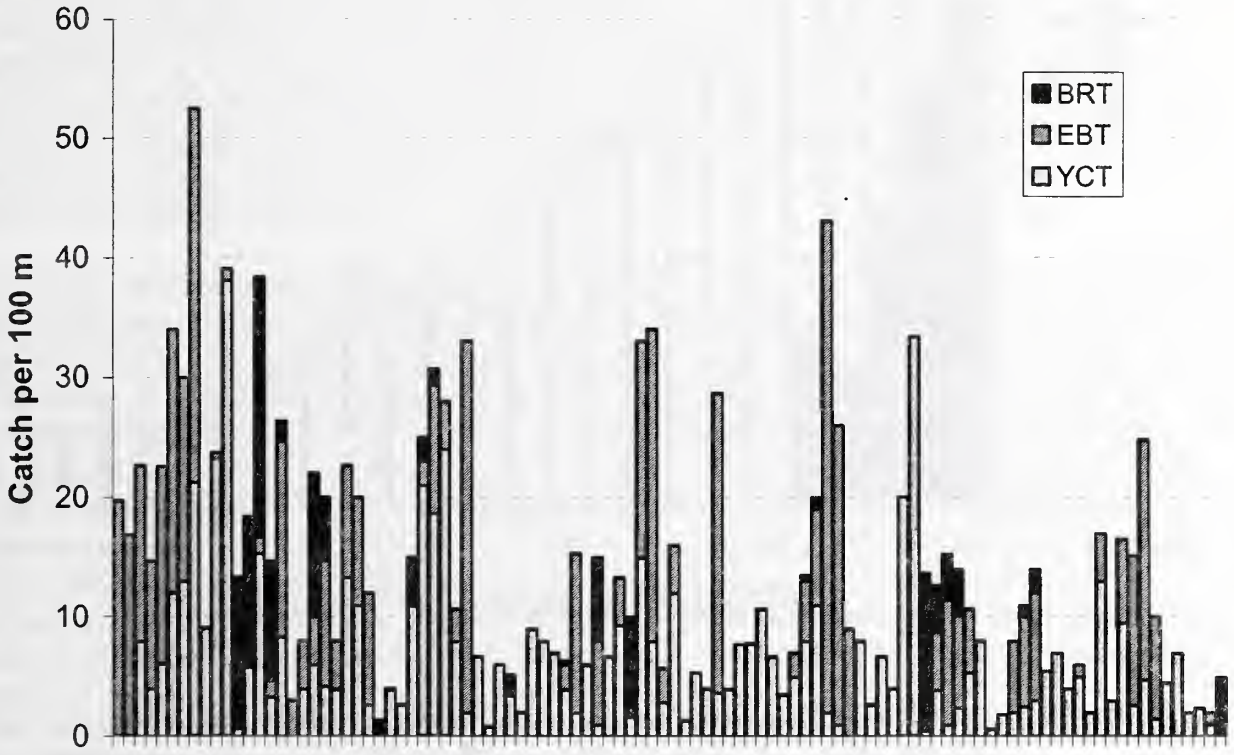

Figure 68. Catches of Yellowstone cutthroat trout (YCT), brook trout (EBT), and brown trout (BRT) standardized to number of fish 75 mm and longer per 100 m of stream length captured in the first electrofishing pass in Shields River tributary sample sections that were sampled from 2000 through 2003.

Fishing pressure in tributaries to the Shields River has generally been relatively light, under 200 angler days per year (Appendix F). Thus, angling harvest should not have influenced fish populations during these surveys. The exception to this trend was seen in Brackett Creek, where angling pressure frequently exceeds 1,000 angler days per year. This compares to pressure of 3,000-6,000 angler days per year expended on the Shields River (Appendix F).

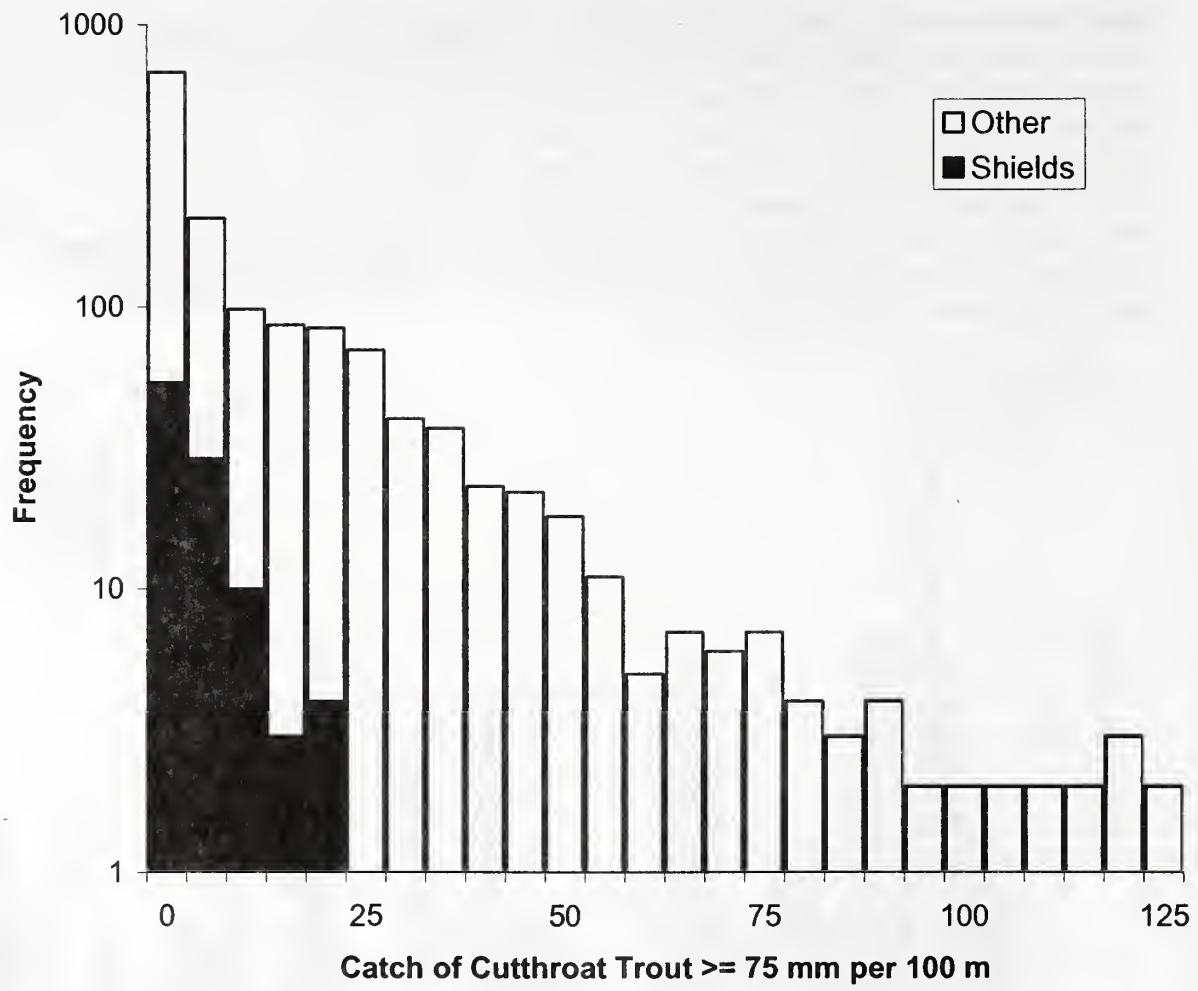

Figure 69. Frequencies (log_{10} scale) of catches of cutthroat trout (standardized to number of fish 75 mm and longer per 100 m of stream length captured in the first electrofishing pass) in Shields River tributary sample sections that were sampled from 2000 through 2003 (Shields) compared to catches of cutthroat trout (both Yellowstone and westslope) throughout central Montana (Other).

Change in Fish Communities Over Time

Recent declines in relative fish abundances (Figure 59, top) were likely related primarily to drought conditions that persisted in the region from 2000 to 2003 (Figure 2); however, increasing human activities within the basin may also have contributed to these declines. There was an obvious spatial trend in species compositions in the Shields River drainage over time with allopatric YCT populations found only in the very headwaters of the drainage, brook trout invasion recently occurring in streams near the headwaters, and brook trout proportions increasing in most other sections where they occurred (Figure 70). The invasion of brook trout occurred from 1974 to 1990 in Deep Creek and may have occurred during this same time period in Mill Creek, but there are no data for this stream from 1974 to 2003 (Figure 59). The displacement of YCT by brook trout appears to be progressing in some sections, but may have stabilized in areas of the lower basin (Figure 59). The decline of rainbow trout in Cottonwood Creek was an interesting phenomenon and may be related to the discontinuation of rainbow trout stocking by FWP after 1968 (Appendix B). The two sections in Cottonwood Creek were the only sections where the proportion of YCT increased noticeably. It is likely that the reduction in rainbow trout abundance allowed YCT to increase.

I suspected that water temperature might play a role in invasion success of brook trout (Dunham et al. 2002); however, thermograph data from 2003 indicated that summer water temperatures were very different in sites where brook trout had successfully invaded (Figures 71 to 74). While water temperatures were relatively warm in many of the streams where brook trout had successfully invaded (Figures 71 and 73), water temperatures remained cool in another stream where brook trout had invaded (Deep Creek; Figure 73). Water temperatures in Flathead Creek went up initially through July, but then dropped in August. I suspect that as a higher proportion of the surface flows of Flathead Creek were diverted for irrigation in mid- to late-summer, more of the remaining flow in Flathead Creek was derived from groundwater sources, thus late summer water temperatures were relatively stable and cooler. I plan to conduct more detailed analyses in the future to determine if any environmental variables might explain why brook trout could successfully invade habitats historically occupied by YCT.

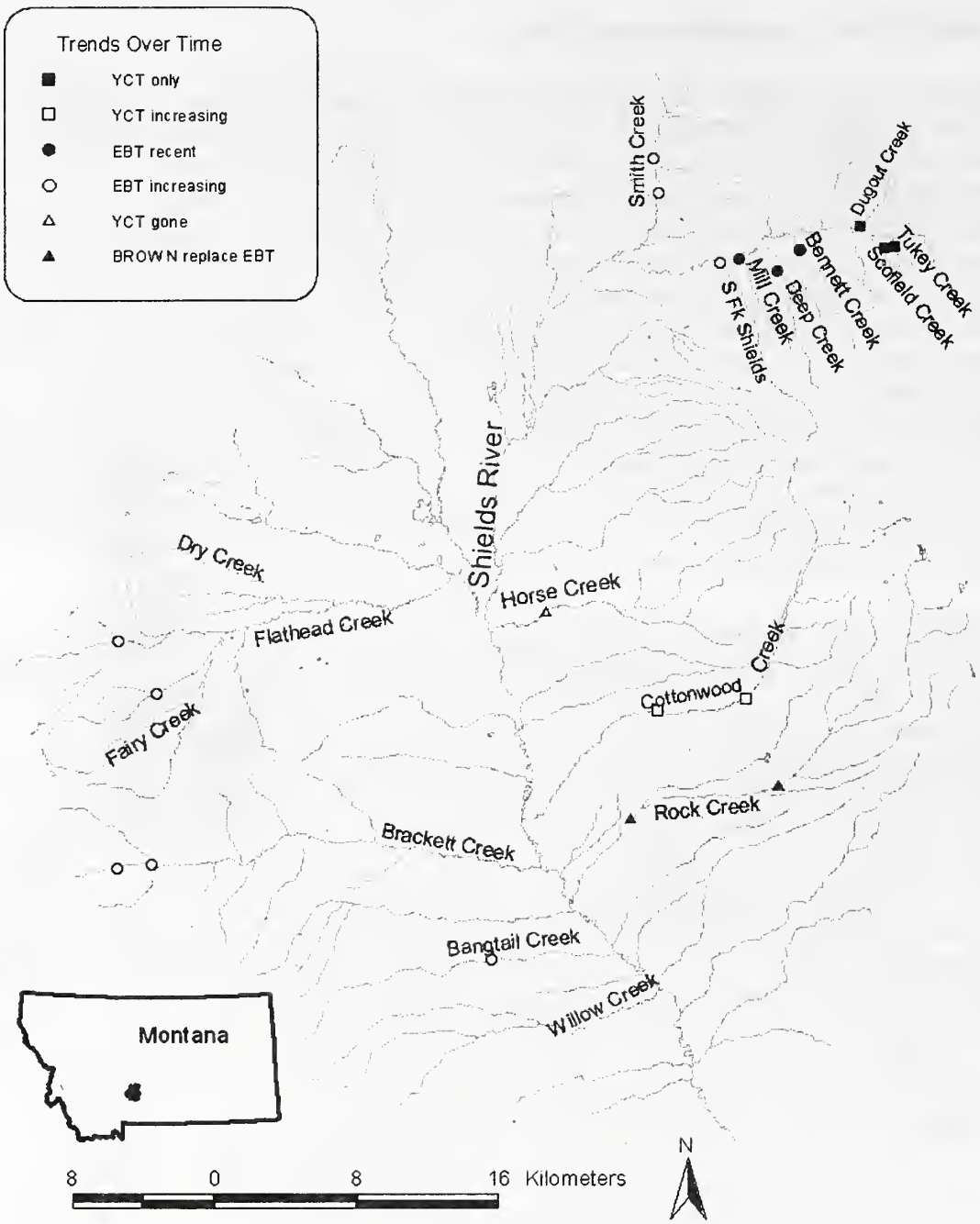

Figure 70. Trends of species composition in selected Shields River tributary sample sections from 1974 through 2003 showing where Yellowstone cutthroat trout existed in allopatry (YCT only), where YCT were increasing, where invasion of brook trout had occurred since 1974 (EBT recent), where the proportion of brook trout had increased (EBT increasing), where no trout were recently found (YCT gone), and where brown trout had apparently been replacing brook trout (BROWN replace EBT).

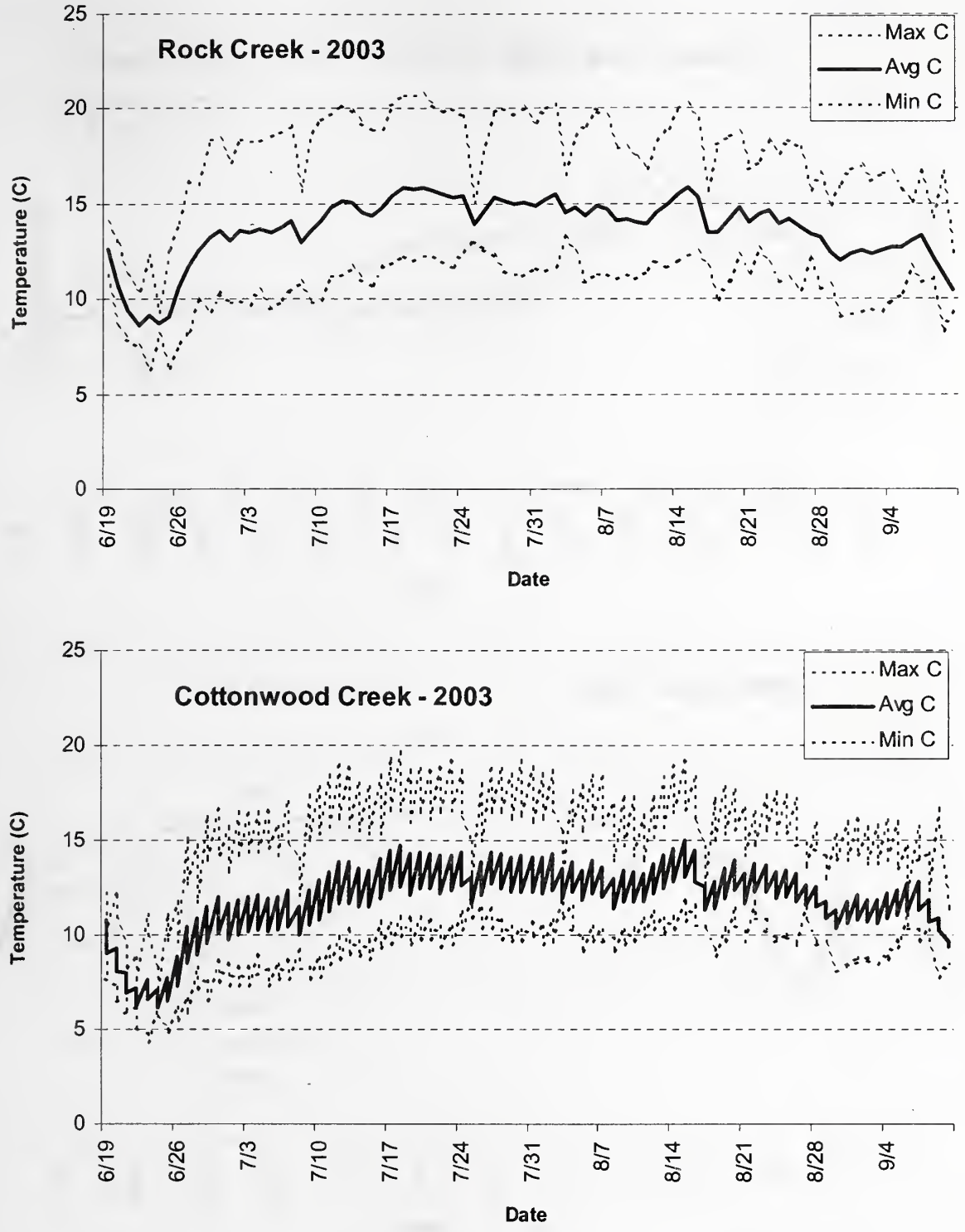

Figure 71. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in Rock and Cottonwood creeks during late-June through September 2003. Daily fluctuations in Cottonwood Creek may indicate the thermograph either was in more direct sunlight or the water level occasionally dropped to expose the thermograph.

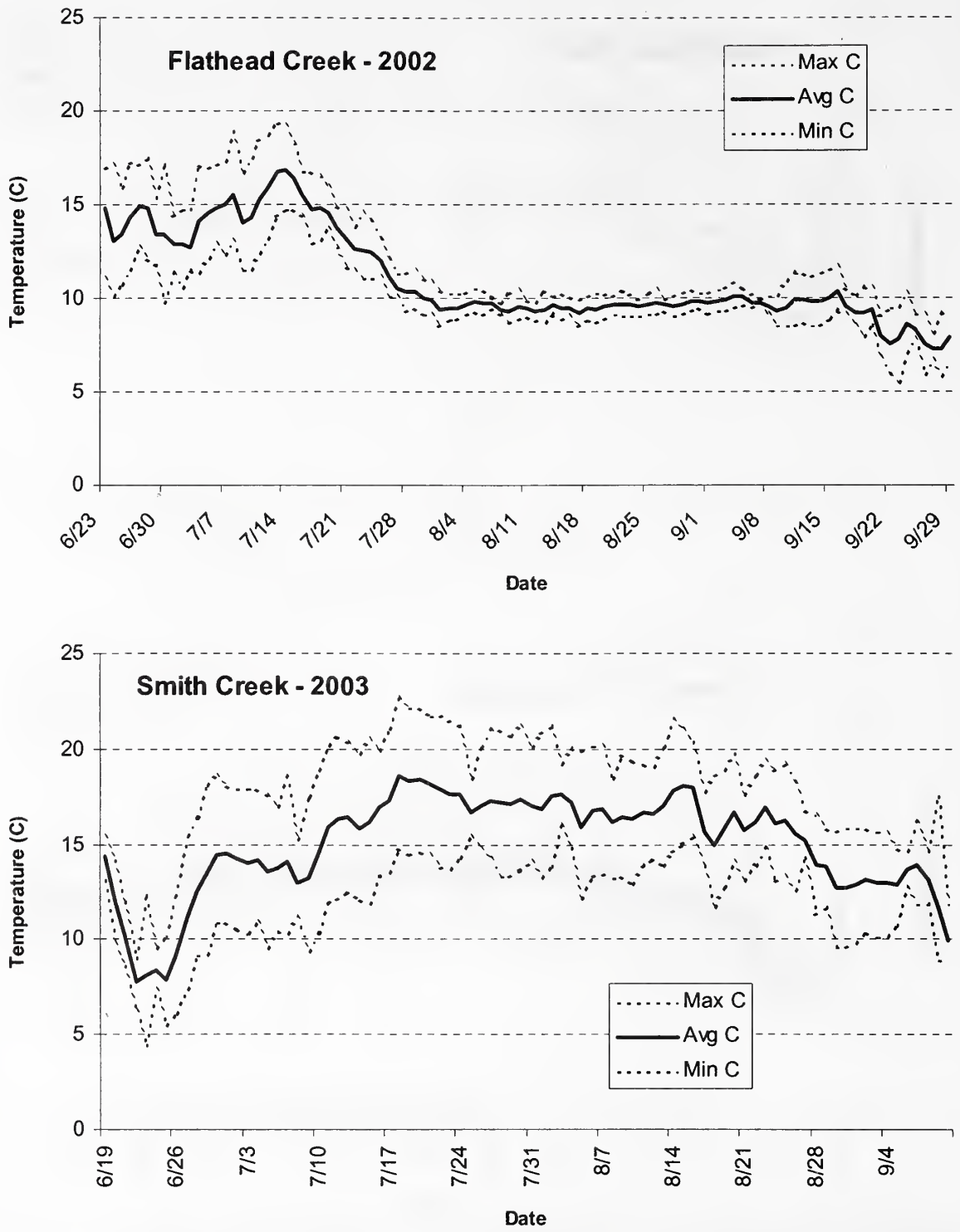

Figure 72. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in Flathead and Smith creeks during late-June through September 2003.

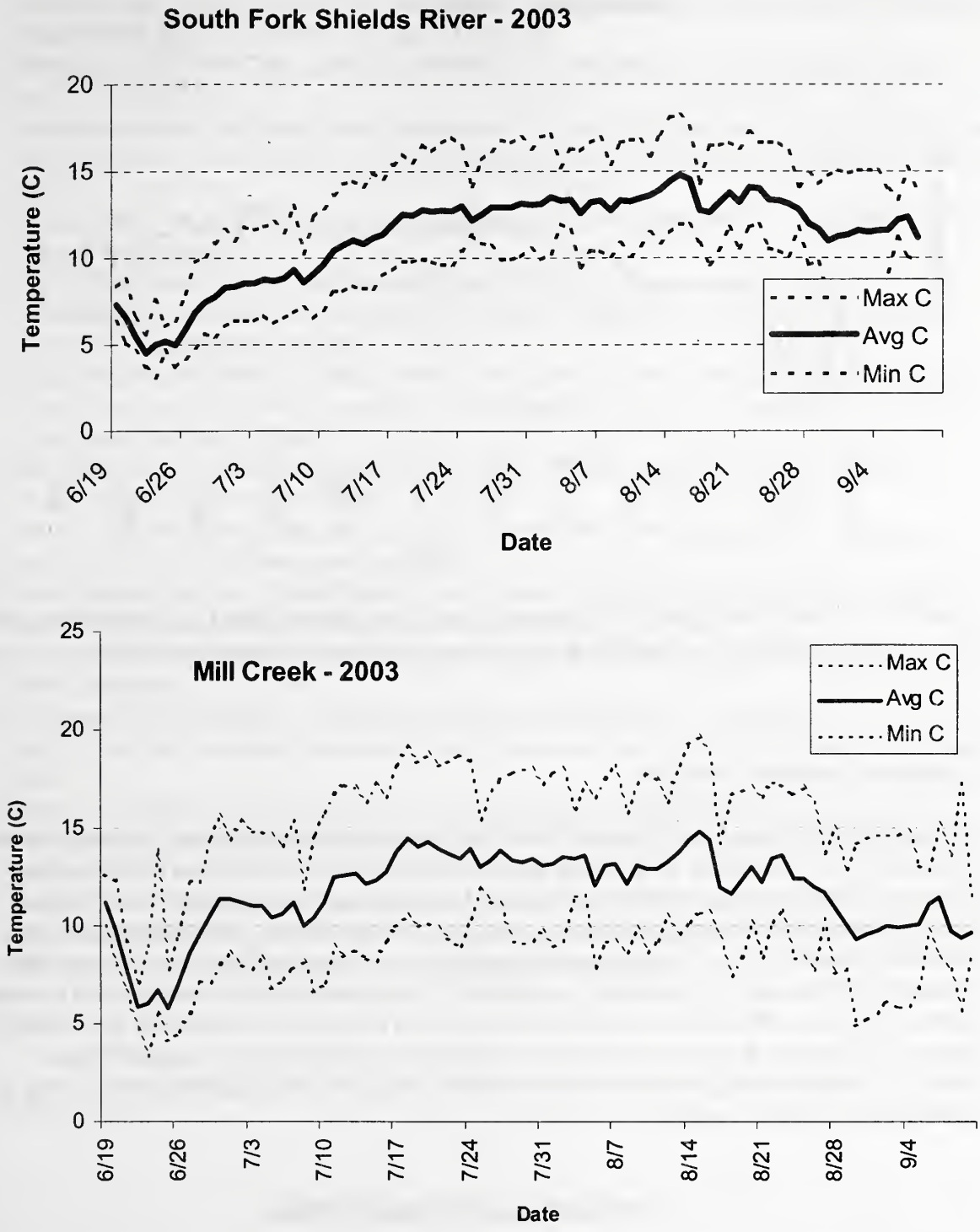

Figure 73. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in South Fork Shields River and Mill Creek during late-June through September 2003.

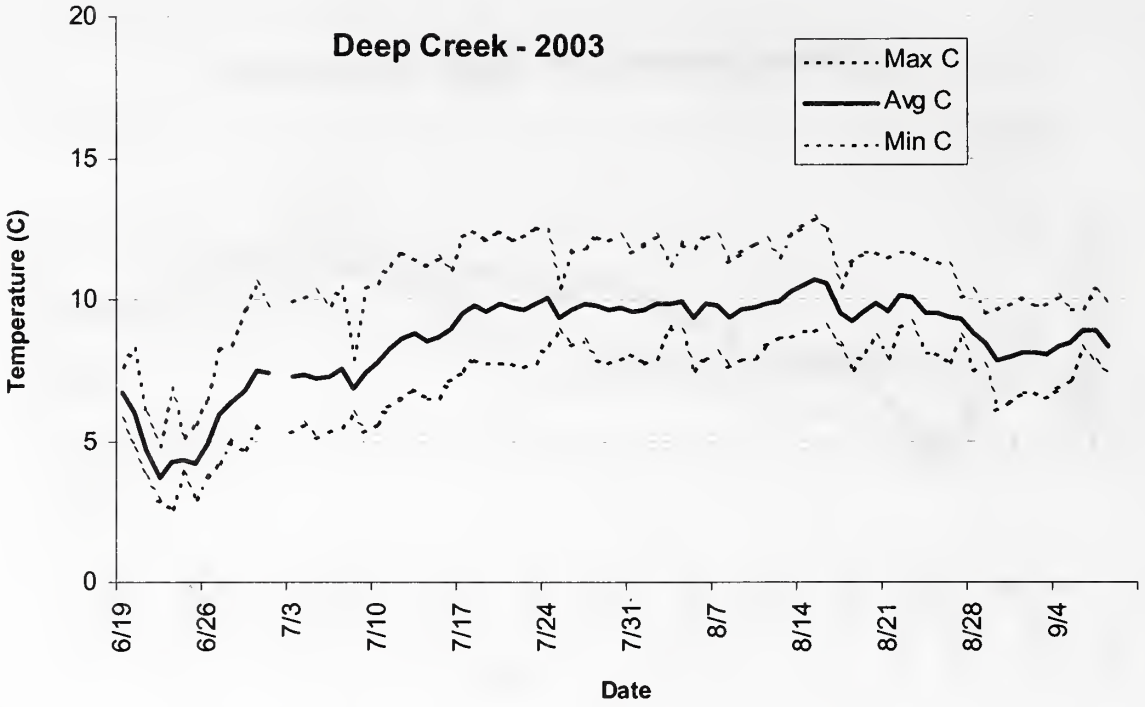

Figure 74. Average (solid line), minimum and maximum (dashed lines) daily water temperatures (°C) recorded in Deep Creek during late-June through September 2003.

Condition of Aquatic Habitats

Aquatic habitats were generally in good condition in most tributary streams; however, the lower portions of many tributaries were found to have extremely low flows due to both irrigation withdrawals and drought conditions experienced during sampling. Impacts from livestock grazing along stream channels were widespread, but only severe at a few locations. Many locations appeared to have been impacted by past livestock grazing, but some of these areas appeared to be recovering from these past impacts. Road and timber harvest impacts to stream channels were also observed at several locations. High levels of fine sediments were found in many of the streams; however, the sources of these fine sediments were often difficult to identify. High water temperatures were recorded at many sites and high temperature may be limiting trout in some locations.

Conclusions and Recommendations

1. Yellowstone cutthroat trout are still widely distributed throughout the Shields River drainage.
2. Most Yellowstone cutthroat trout populations had either no evidence of introgression, or very low (< 8%) levels of introgression with rainbow or westslope cutthroat trout.

3. Brook trout were widely distributed in middle and headwater reaches of most tributaries, the upper portion of the Shields River, and the lower portion of many tributaries that entered the Shields River above the town of Wilsall, Montana.
4. Distributions of brook trout generally overlapped distributions of Yellowstone cutthroat trout.
5. Evidence suggests that brook trout are still invading into the headwaters of the Shields River and its upper tributaries and they apparently are continuing to displace Yellowstone cutthroat trout.
6. Brown trout were distributed throughout the main Shields River and the lower portions of most of its tributaries.
7. Brown trout appeared to have displaced brook trout in Rock Creek since 1974.
8. Rainbow trout are currently restricted to the lower Shields River and the lower reaches of Cottonwood and Brackett creeks.
9. Rainbow trout have declined since 1974 in Cottonwood Creek, perhaps because stocking was discontinued, and Yellowstone cutthroat trout appeared to have rebounded after the decline of rainbow trout in this creek.
10. Mottled sculpin occurred throughout much of the Shields drainage, but they appeared to be absent from the highest elevations.
11. Aquatic habitats were in generally good conditions, but some impacts from livestock grazing, roads, and timber activities were observed.
12. Some streams had very limited flows in their lower reaches and many streams had high summer water temperatures that approached lethal levels for trout.
13. I recommend that a systematic sampling survey be conducted for upper and east side Shields River tributaries.
14. I suggest that brook trout be experimentally removed from one or more tributary streams to test whether this conservation strategy might improve populations of Yellowstone cutthroat trout.
15. Rainbow trout may be invading into the middle portion of the Shields drainage and its tributaries and their invasion and potential to hybridize with Yellowstone cutthroat trout warrant further efforts to reduce or eliminate their spread.
16. An, as yet, unidentified source of rainbow trout appears to be present in the Cache Creek area of the Flathead Creek drainage that is beginning to contaminate the wild YCT in this area. This source of rainbow trout should be found and eliminated.

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Appendix A. DRAFT Montana Level IV Ecoregion Descriptions
REVISED 11/06/01

These ecoregion descriptions were obtained from the US EPA ftp site: ftp://ftp.epa.gov/wed/ecoregions/mt/.

17g. The carbonate-rich **Absaroka-Gallatin-Madison-Bridger Sedimentary Mountains** ecoregion is mostly forested, partially glaciated, and, generally, less rugged than the neighboring Gneissic-Schistose Forested Mountains (17l) and Absaroka-Gallatin Volcanic Mountains (17i), from which it is lithologically distinct. Ecoregion 17g is characteristically underlain by faulted and folded Mesozoic and Paleozoic sedimentary rocks, including limestone. Stream quality, surficial water availability, and aquatic biota are also different. Average annual precipitation ranges from less than 20 to just over 40 inches. Climax vegetation is mapped as subalpine fir and Douglas-fir forests. Logging, grazing, mining, and recreation are the common land uses.

17h. The high, wet, severely exposed **High Elevation Rockland Alpine Zone** ecoregion was glaciated and is characterized by jagged peaks, mixed high altitude vegetation, many tarns, rockland, and talus deposits. It is similar to the High Northern Rockies (15h), High Idaho Batholith (16h) and the Crestal Alpine-Subalpine Zone (41b) that occur in different level III ecoregions. Elevations range from about 8,500 to just over 12,500 feet. Average annual precipitation ranges from 30 to 100 inches and exceeds that of surrounding, but lower, ecoregions. Ecoregion 17h is often snowcapped for most of the year; permafrost occurs sporadically and solifluction has created patterned-ground in the alpine areas of the Beartooth Plateau. The soils are Udic, Cryic, Inceptisols and are typically very gravelly to stony. They support subalpine fir and whitebark pine forests in glacial cirques. Above timberline, alpine tundra, alpine grassland, subirrigated meadows, and wetlands occur. Krummholz vegetation occupies windswept areas between the forest and higher alpine areas.

17i. The high, forested, partially glaciated **Absaroka-Gallatin Volcanic Mountains** ecoregion has rock outcrops, volcanic mud flows, and extensive glacial drift and colluvial deposits. It is underlain primarily by pyroclastic material, Tertiary volcanic flows, and water-laid volcanics. The Absaroka-Gallatin Volcanic Mountains (17i) is lithologically distinct from the Absaroka-Gallatin-Madison-Bridger Sedimentary Mountains (17g) and Gneissic-Schistose Forested Mountains (17l). Its air-fall volcanics readily weather to clay and tend to muddy the streams of Ecoregion 17i making them more turbid than those of Ecoregion 17l. Percolation rates are high and water tables are commonly perched, especially in unglaciated areas. Storm hydrographs show considerably greater lag time between rainfall and runoff than in the Gneissic-Schistose Forested Mountains (17l). Springs and wetlands are common. Climax vegetation is mapped as subalpine fir and Douglas-fir forests; it differs from that of the higher High Elevation Rockland Alpine Zone (17h). Recreation, grazing, logging, and mining are common land uses.

17l. The rugged, glaciated **Gneissic-Schistose Forested Mountains** ecoregion is wet and mostly forested. Ecoregion 17l is characteristically underlain by Precambrian pre-Belt gneiss and schist and rock outcrops occur. Its streams are generally clearer and have lower concentrations of dissolved calcium and magnesium than those in the lithologically distinct Absaroka-Gallatin

Volcanic Mountains (17i). Low stream flows occur during drought and freezing periods. Typically, there is only a short time lag between rainfall and runoff peak and, consequently, storm hydrographs are flashy. Average annual precipitation ranges from less than 20 to 100 inches; maximums are much greater than those of the Eastern Gravelly Mountains (17d) but less than those of the higher High Elevation Rockland Alpine Zone (17h). The climax vegetation is mapped as subalpine fir and Douglas-fir forests. Recreation and logging are the common land uses in the Gneissic-Schistose Forested Mountains (17l) and some grazing also occurs.

43s. Non-calcareous Foothill Grassland

43t. The broad, mostly treeless **Shield-Smith Valleys** ecoregion lies east of the Continental Divide. It is mostly underlain by Tertiary sediments and late-Cretaceous water-laid volcanics which are unlike the carbonate-rich, Mesozoic-Paleozoic sedimentary rocks of the Limy Foothill Grassland (43u). Stream quality and aquatic biota are also distinct from those of Ecoregion 43u. Potential natural vegetation consists of sagebrush steppe and foothills prairie; it contrasts with the foothills prairie and grama-needlegrass-wheatgrass of the Townsend Basin (17w). Currently, the area is mostly grazed in contrast to the nearby but lower Ecoregion 17w which has a mix of farming, grazing, and urban-suburban-industrial land uses.

Appendix B. Fish released (stocked) into streams draining into the Shields River from the west from Montana Department of Fish, Wildlife and Parks fish plant database.

Date	Water	Species	Strn	#	Len	Wt	Reg	County	Location
05/22/1942	Bangtail Creek	Brown Trout		5,000	2.0	0.00	3	Park	01N09E24
06/18/1943	Bangtail Creek	Brown Trout		5,000	2.0	0.00	3	Park	01N09E24
06/30/1944	Bangtail Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E24
07/07/1945	Bangtail Creek	Brown Trout		8,000	2.0	0.00	3	Park	01N09E24
07/23/1946	Bangtail Creek	Brown Trout		5,000	2.0	0.00	3	Park	01N09E24
07/07/1948	Bangtail Creek	Brown Trout		6,000	2.0	0.00	3	Park	01N09E24
06/10/1952	Bangtail Creek	Brook Trout		5,000	2.0	0.00	3	Park	01N09E24
05/26/1953	Bangtail Creek	Brook Trout		10,720	1.0	10.00	3	Park	01N09E24
06/27/1947	Basin Creek	Brook Trout		8,000	2.0	0.00	3	Park	03N10E29
07/08/1948	Basin Creek	Brown Trout		25,000	2.0	0.00	3	Park	03N10E29
09/13/1951	Basin Creek	Cutthroat Trout		5,000	1.0	0.00	3	Park	03N10E29
09/16/1941	Bennett Creek	Cutthroat Ylst		8,400	0.0	0.00	3	Park	05N10E24
08/27/1942	Bennett Creek	Cutthroat Ylst		5,000	2.0	0.00	3	Park	05N10E24
09/08/1944	Bennett Creek	Cutthroat Ylst		5,000	2.0	0.00	3	Park	05N10E24
09/24/1945	Bennett Creek	Cutthroat Trout		5,000	2.0	0.00	3	Park	05N10E24
09/05/1946	Bennett Creek	Cutthroat Trout		14,096	2.0	0.00	3	Park	05N10E24
10/08/1948	Bennett Creek	Cutthroat Trout		10,000	0.0	0.00	3	Park	05N10E24
09/09/1949	Bennett Creek	Cutthroat Trout		8,000	1.0	0.00	3	Park	05N10E24
09/19/1950	Bennett Creek	Cutthroat Trout		5,000	1.0	0.00	3	Park	05N10E24
09/16/1993	Boyd's Reservoir	Cutthroat Ylst	M	10,004	2.8		3	Park	04N09E17
09/22/1994	Boyd's Reservoir	Cutthroat Ylst	M	10,080	2.0	27.07	3	Park	04N09E17
08/23/1995	Boyd's Reservoir	Cutthroat Ylst	M	10,000	2.4	46.00	3	Park	04N9E17
08/15/1928	Brackett Creek	Cutthroat Trout		40,000	1.0	0.00	3	Park	01N09E03
06/22/1931	Brackett Creek	Cutthroat Trout		8,000	4.0	0.00	3	Park	01N09E03
10/13/1932	Brackett Creek	Cutthroat Trout		39,200	0.0	0.00	3	Park	01N09E03
07/31/1939	Brackett Creek	Cutthroat Ylst		56,000	0.0	0.00	3	Park	01N09E03
08/26/1940	Brackett Creek	Cutthroat Ylst		25,000	0.0	0.00	3	Park	01N09E03
08/05/1941	Brackett Creek	Cutthroat Ylst		4,600	5.0	0.00	3	Park	01N09E03
06/17/1943	Brackett Creek	Brown Trout		15,000	2.0	0.00	3	Park	01N09E03
06/26/1944	Brackett Creek	Brown Trout		25,000	2.0	0.00	3	Park	01N09E03
07/07/1945	Brackett Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E03
06/20/1946	Brackett Creek	Brook Trout		19,200	3.0	0.00	3	Park	01N09E03
07/23/1946	Brackett Creek	Brown Trout		25,000	2.0	0.00	3	Park	01N09E03
05/19/1947	Brackett Creek	Brown Trout		25,000	1.0	0.00	3	Park	01N09E03
06/17/1947	Brackett Creek	Brown Trout		30,000	2.0	0.00	3	Park	01N09E03
09/29/1947	Brackett Creek	Brook Trout		13,200	3.0	0.00	3	Park	01N09E03
06/21/1948	Brackett Creek	Brown Trout		25,000	2.0	0.00	3	Park	01N09E03
06/12/1950	Brackett Creek	Brown Trout		25,000	2.0	0.00	3	Park	01N09E03
07/24/1950	Brackett Creek	Brook Trout		5,000	4.0	0.00	3	Park	01N09E03
08/03/1951	Brackett Creek	Brook Trout		4,950	4.0	0.00	3	Park	01N09E03
09/18/1951	Brackett Creek	Brook Trout		6,000	3.0	80.00	3	Park	01N09E03
05/14/1952	Brackett Creek	Brook Trout		14,400	3.0	0.00	3	Park	01N09E03
07/12/1960	Brackett Creek	Rainbow Trout		1,080	0.0	200.00	3	Park	01N09E01
07/31/1961	Brackett Creek	Rainbow Trout		1,017	0.0	226.00	3	Park	01N09E01
07/26/1962	Brackett Creek	Rainbow Trout		1,024	7.0	160.00	3	Park	01N09E03
07/31/1962	Brackett Creek	Rainbow Trout		1,024	7.0	160.00	3	Park	01N09E03
07/22/1963	Brackett Creek	Rainbow Trout		1,000	8.0	250.00	3	Park	01N09E01
08/12/1965	Brackett Creek	Rainbow Trout		1,000	7.0	200.00	3	Park	01N09E07
08/01/1967	Brackett Creek	Rainbow Trout		1,224	9.0	510.00	3	Park	01N09E09
07/17/1968	Brackett Creek	Rainbow Trout		1,071	9.0	510.00	3	Park	01N09E03
08/26/1942	Buck Creek	Cutthroat Ylst		8,000	2.0	0.00	3	Park	05N11E17
10/05/1943	Buck Creek	Cutthroat Ylst		12,000	2.0	0.00	3	Park	05N11E17
09/07/1944	Buck Creek	Cutthroat Ylst		7,000	2.0	0.00	3	Park	05N11E17
09/08/1949	Cache Creek	Cutthroat Trout		12,000	1.0	0.00	3	Park	03N07E27
09/19/1950	Cache Creek	Cutthroat Trout		5,000	1.0	0.00	3	Park	03N07E27
08/12/1939	Campfire Lake	Cutthroat Ylst		18,800	0.0	0.00	5	Park	04N11E30
08/07/1980	Campfire Lake	Cutthroat Ylst	M	4,009	2.0	14.00	5	Park	04N11E30
08/21/1984	Campfire Lake	Cutthroat Ylst	M	5,310	2.0	12.00	5	Park	04N11E30
08/02/1988	Campfire Lake	Cutthroat Ylst	M	5,303	2.0	14.40	5	Park	04N11E30
07/29/1992	Campfire Lake	Cutthroat Ylst	M	5,310	1.9	12.33	5	Park	04N11E30
08/07/2000	Campfire Lake	Cutthroat Ylst	M	5,310	2.1	17.06	5	Park	04N11E30

05/22/1942	Canyon Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E14
06/18/1943	Canyon Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E14
06/30/1944	Canyon Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E14
07/07/1945	Canyon Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E14
07/23/1946	Canyon Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E14
05/19/1947	Canyon Creek	Brown Trout		10,000	1.0	0.00	3	Park	01N09E14
07/07/1948	Canyon Creek	Brown Trout		12,000	2.0	0.00	3	Park	01N09E14
06/12/1950	Canyon Creek	Brown Trout		10,000	2.0	0.00	3	Park	01N09E14
09/08/1952	Canyon Creek	Cutthroat Trout		10,000	1.0	0.00	3	Park	01N09E14
09/10/1980	Cave Lake	Golden Trout	S	1,300	1.0	1.00	5	Park	04N11E26
09/15/1984	Cave Lake	Golden Trout	S	5,000	1.0	1.00	5	Park	04N11E26
06/05/1947	Cottonwood Creek	Brown Trout		25,000	2.0	0.00	3	Park	03N08E01
09/07/1949	Cottonwood Creek	Cutthroat Trout		40,000	1.0	0.00	3	Park	03N08E01
06/13/1950	Cottonwood Creek	Brown Trout		25,000	2.0	0.00	3	Park	03N08E01
09/20/1950	Cottonwood Creek	Cutthroat Trout		42,000	1.0	0.00	3	Park	06S06E27
09/12/1951	Cottonwood Creek	Cutthroat Trout		15,000	1.0	0.00	3	Park	02N09E23
09/21/1954	Cottonwood Creek	Cutthroat Trout		25,000	1.0	21.00	3	Park	02N09E23
07/18/1957	Cottonwood Creek	Rainbow Trout		2,844	0.0	711.0	3	Park	02N09E23
07/09/1958	Cottonwood Creek	Rainbow Trout		2,025	0.0	450.0	3	Park	02N09E28
07/09/1958	Cottonwood Creek	Rainbow Trout		2,025	0.0	450.0	3	Park	02N09E09
07/17/1959	Cottonwood Creek	Rainbow Trout		1,003	0.0	223.0	3	Park	02N09E09
07/17/1959	Cottonwood Creek	Rainbow Trout		1,003	0.0	223.0	3	Park	02N09E09
06/27/1960	Cottonwood Creek	Rainbow Trout		1,734	0.0	340.0	3	Park	02N09E09
06/21/1961	Cottonwood Creek	Rainbow Trout		1,624	0.0	280.0	3	Park	02N09E09
06/23/1961	Cottonwood Creek	Rainbow Trout		1,624	0.0	280.0	3	Park	02N09E09
07/27/1962	Cottonwood Creek	Rainbow Trout		1,024	7.0	160.0	3	Park	02N09E28
07/24/1963	Cottonwood Creek	Rainbow Trout		1,000	8.0	250.0	3	Park	02N09E09
08/05/1964	Cottonwood Creek	Rainbow Trout		690	10.0	300.0	3	Park	02N09E09
08/12/1965	Cottonwood Creek	Rainbow Trout		1,000	7.0	200.0	3	Park	02N09E09
07/19/1966	Cottonwood Creek	Rainbow Trout		632	8.0	253.0	3	Park	02N09E09
08/01/1967	Cottonwood Creek	Rainbow Trout		1,224	9.0	510.0	3	Park	02N09E09
07/17/1968	Cottonwood Creek	Rainbow Trout		1,071	9.0	510.0	3	Park	02N09E28
08/19/1963	Cottonwood Lake	Cutthroat Trout		450	3.0	5.00	3	Park	03N11E02
07/31/1969	Cottonwood Lake	Cutthroat Ylst		1,045	3.0	11.0	3	Park	03N11E02
07/29/1972	Cottonwood Lake	Cutthroat Ylst		1,536	3.0	24.0	3	Park	03N11E02
08/11/1976	Cottonwood Lake	Cutthroat Ylst	M	1,064	2.0	3.0	3	Park	03N11E02
07/17/1979	Cottonwood Lake	Cutthroat Ylst	M	1,010	2.0	3.0	3	Park	03N11W02
08/21/1984	Cottonwood Lake	Cutthroat Ylst	M	1,000	2.0	2.0	3	Park	03N11E03A
08/02/1988	Cottonwood Lake	Cutthroat Ylst	M	994	2.0	2.7	3	Park	03N11E02
07/29/1992	Cottonwood Lake	Cutthroat Ylst	M	920	1.9	2.1	3	Park	03N11E02
08/13/1996	Cottonwood Lake	Cutthroat Ylst	M	920	2.3	3.8	5	Park	03N11E02
09/13/2000	Cottonwood Lake	Cutthroat Ylst	M	920	2.5	4.7	5	Park	03N11E23
09/19/1990	Cottonwood Reservoir	Cutthroat Ylst	M	15,089	1.9	33.0	3	Park	03N08E01
09/16/1941	Crandall Creek	Cutthroat Ylst		4,600	0.0	0.00	5	Park	05N11E00
09/15/1943	Crandall Creek	Cutthroat Ylst		10,000	2.0	0.00	5	Park	05N11E00
09/08/1944	Crandall Creek	Cutthroat Ylst		5,000	2.0	0.00	5	Park	05N11E00
09/09/1948	Crandall Creek	Cutthroat Trout		5,000	0.0	0.00	5	Park	05N11E00
09/09/1949	Crandall Creek	Cutthroat Trout		4,500	1.0	0.00	5	Park	05N11E00
09/18/1950	Crandall Creek	Cutthroat Trout		10,000	1.0	0.00	5	Park	05N11E00
09/10/1952	Crandall Creek	Cutthroat Trout		5,000	1.0	0.00	5	Park	05N11E00
09/03/1928	Daisy Dean Creek	Cutthroat Trout		20,000	1.0	0.00	3	Park	03N09E17
10/25/1933	Daisy Dean Creek	Cutthroat Trout		16,600	0.0	0.00	3	Park	03N09E17
08/16/1939	Daisy Dean Creek	Rainbow Trout		12,500	0.0	0.00	3	Park	03N09E17
06/15/1940	Daisy Dean Creek	Brook Trout		6,000	2.0	0.00	3	Park	03N09E17
05/07/1942	Daisy Dean Creek	Brown Trout		15,000	2.0	0.00	3	Park	03N09E17
05/21/1943	Daisy Dean Creek	Brown Trout		10,000	2.0	0.00	3	Park	03N09E17
06/12/1944	Daisy Dean Creek	Brown Trout		10,000	2.0	0.00	3	Park	03N09E17
06/28/1945	Daisy Dean Creek	Brown Trout		10,000	3.0	0.00	3	Park	03N09E17
09/19/1946	Daisy Dean Creek	Cutthroat Trout		10,000	2.0	0.00	3	Park	03N09E17
09/11/1951	Daisy Dean Creek	Cutthroat Trout		7,000	2.0	0.00	3	Park	03N09E17
09/17/1951	Daisy Dean Creek	Brook Trout		2,000	3.0	26.00	3	Park	03N09E17
09/10/1952	Daisy Dean Creek	Cutthroat Trout		10,000	1.0	0.00	3	Park	03N09E17
08/17/1928	Deep Creek	Cutthroat Trout		26,250	1.0	0.00	3	Park	05N10E22
09/16/1941	Deep Creek	Cutthroat Ylst		1,400	0.0	0.00	3	Park	05N10E22
09/17/1941	Deep Creek	Cutthroat Ylst		9,000	0.0	0.00	3	Park	05N10E22
08/27/1942	Deep Creek	Cutthroat Ylst		10,000	2.0	0.00	3	Park	05N10E22
10/05/1943	Deep Creek	Cutthroat Ylst		12,000	2.0	0.00	3	Park	05N10E22
09/07/1944	Deep Creek	Cutthroat Ylst		8,000	2.0	0.00	3	Park	05N10E22
09/24/1945	Deep Creek	Cutthroat Trout		5,000	2.0	0.00	3	Park	05N10E22
10/08/1948	Deep Creek	Cutthroat Trout		7,000	0.0	0.00	3	Park	05N10E22

09/09/1949	Deep Creek	Cutthroat Trout	7,500	1.0	0.00	3	Park	05N10E22
09/16/1941	Dugout Creek	Cutthroat Ylst	4,200	0.0	0.00	3	Park	05N11E17
08/26/1942	Dugout Creek	Cutthroat Ylst	4,000	2.0	0.00	3	Park	05N11E17
10/05/1943	Dugout Creek	Cutthroat Ylst	5,000	2.0	0.00	3	Park	05N11E17
09/07/1944	Dugout Creek	Cutthroat Ylst	5,000	2.0	0.00	3	Park	05N11E17
09/05/1946	Dugout Creek	Cutthroat Trout	3,976	2.0	0.00	3	Park	05N11E17
09/16/1941	Faun Creek	Cutthroat Ylst	4,200	0.0	0.00	5	Park	05N11E00
08/02/1928	Flathead Creek	Cutthroat Trout	104,000	1.0	0.00	3	Park	03N09E18
10/17/1932	Flathead Creek	Cutthroat Trout	39,200	0.0	0.00	3	Park	03N09E18
07/22/1936	Flathead Creek	Cutthroat Ylst	29,000	0.0	0.00	3	Park	03N09E18
08/21/1937	Flathead Creek	Brook Trout	5,000	4.0	0.00	3	Park	03N09E18
06/27/1938	Flathead Creek	Brook Trout	13,440	2.0	0.00	3	Park	03N09E18
05/06/1940	Flathead Creek	Brook Trout	16,000	0.0	0.00	3	Park	03N09E18
06/14/1940	Flathead Creek	Brook Trout	24,000	2.0	0.00	3	Park	03N09E18
06/12/1941	Flathead Creek	Brook Trout	16,500	2.0	0.00	3	Park	03N09E18
03/05/1942	Flathead Creek	Brown Trout	65,000	0.0	0.00	3	Park	03N09E18
06/17/1943	Flathead Creek	Brown Trout	20,000	2.0	0.00	3	Park	03N09E18
06/26/1944	Flathead Creek	Brown Trout	20,000	2.0	0.00	3	Park	03N09E18
10/14/1944	Flathead Creek	Cutthroat Ylst	30,000	2.0	0.00	3	Park	03N09E18
06/24/1945	Flathead Creek	Brown Trout	25,000	2.0	0.00	3	Park	03N09E18
07/07/1945	Flathead Creek	Brown Trout	17,000	2.0	0.00	3	Park	03N09E18
06/19/1946	Flathead Creek	Brown Trout	20,000	2.0	0.00	3	Park	03N09E18
05/25/1947	Flathead Creek	Brown Trout	7,000	2.0	0.00	3	Park	03N09E18
06/22/1948	Flathead Creek	Brown Trout	20,000	2.0	0.00	3	Park	03N09E18
10/05/1948	Flathead Creek	Cutthroat Trout	25,000	0.0	0.00	3	Park	03N09E18
07/08/1949	Flathead Creek	Cutthroat Trout	10,000	1.0	0.00	3	Park	03N09E18
09/08/1949	Flathead Creek	Cutthroat Trout	5,000	1.0	0.00	3	Park	03N09E18
09/08/1949	Flathead Creek	Cutthroat Trout	15,000	1.0	0.00	3	Park	03N09E18
09/19/1950	Flathead Creek	Cutthroat Trout	5,000	1.0	0.00	3	Park	03N09E18
06/25/1951	Flathead Creek	Brown Trout	22,400	2.0	0.00	3	Park	03N09E18
06/05/1952	Flathead Creek	Brown Trout	20,000	2.0	0.00	3	Park	03N09E18
06/27/1939	Hammond Creek	Brook Trout	6,667	2.0	0.00	3	Park	02N10E30
06/11/1940	Hammond Creek	Brook Trout	5,400	2.0	0.00	3	Park	02N10E30
05/09/1942	Hammond Creek	Brown Trout	5,000	2.0	0.00	3	Park	02N10E30
08/12/1958	Hetzil Pond	Rainbow Trout	1,998	3.0	18.0	3	Park	01N11E29
05/26/1950	Hoffman Reservoir	Brook Trout	2,000	2.0	0.0	3	Park	02N10E26
08/12/1958	Hoffman Reservoir	Rainbow Trout	1,998	3.0	19.00	3	Park	02N10E26
06/15/1940	Lena Creek	Brook Trout	6,000	2.0	0.00	3	Park	04N09E12
09/11/1951	Lena Creek	Cutthroat Trout	14,000	2.0	0.00	3	Park	04N09E12
09/17/1951	Lena Creek	Brook Trout	6,000	3.0	0.00	3	Park	04N09E12
08/22/1940	Little Cottonwood	Cutthroat Ylst	10,400	0.0	0.00	3	Park	03N10E00
06/11/1940	Little Indian Creek	Brook Trout	5,400	2.0	0.00	3	Park	02N09E09
06/18/1943	Little Rock Creek	Brown Trout	15,000	2.0	0.00	3	Park	02N11E00
06/30/1944	Little Rock Creek	Brown Trout	5,000	2.0	0.00	3	Park	02N11E00
06/24/1945	Little Rock Creek	Brown Trout	10,000	2.0	0.00	3	Park	02N11E00
07/24/1946	Little Rock Creek	Brown Trout	5,000	2.0	0.00	3	Park	02N11E00
09/10/1949	Little Rock Creek	Cutthroat Trout	10,000	1.0	0.00	3	Park	02N11E00
09/18/1950	Little Rock Creek	Cutthroat Trout	7,000	1.0	0.00	3	Park	02N11E00
09/08/1952	Little Rock Creek	Cutthroat Trout	5,000	1.0	0.00	3	Park	02N11E00
08/26/1942	Lodgepole Creek	Cutthroat Ylst	4,000	2.0	0.00	3	Park	05N10E23
09/15/1943	Lodgepole Creek	Cutthroat Ylst	3,000	2.0	0.00	3	Park	05N10E23
09/07/1944	Lodgepole Creek	Cutthroat Ylst	5,000	2.0	0.00	3	Park	05N10E23
09/05/1946	Lodgepole Creek	Cutthroat Trout	3,976	2.0	0.00	3	Park	05N10E23
09/09/1948	Lodgepole Creek	Cutthroat Trout	6,000	0.0	0.00	3	Park	05N10E23
09/18/1950	Lodgepole Creek	Cutthroat Trout	10,000	1.0	0.00	3	Park	05N10E23
09/10/1952	Lodgepole Creek	Cutthroat Trout	5,000	1.0	0.00	3	Park	05N10E23
05/07/1942	M Fk Horse Creek	Brown Trout	10,000	2.0	0.00	3	Park	03N10E17
05/21/1943	M Fk Horse Creek	Brown Trout	5,000	2.0	0.00	3	Park	03N10E17
06/12/1944	M Fk Horse Creek	Brown Trout	5,000	2.0	0.00	3	Park	03N10E17
06/28/1945	M Fk Horse Creek	Brown Trout	5,000	3.0	0.00	3	Park	03N10E17
06/05/1947	M Fk Horse Creek	Brown Trout	5,000	2.0	0.00	3	Park	03N10E17
07/06/1948	M Fk Horse Creek	Brown Trout	5,000	2.0	0.00	3	Park	03N10E17
09/12/1951	M Fk Horse Creek	Cutthroat Trout	10,000	1.0	0.00	3	Park	03N10E17
09/09/1952	M Fk Horse Creek	Cutthroat Trout	5,000	1.0	0.00	3	Park	03N10E17
09/19/1951	Mill Creek	Cutthroat Trout	15,000	2.0	0.00	3	Park	05N10E27
10/10/1931	Moose Lake	Cutthroat Trout	7,040	2.0	0.00	5	Park	04N11E29
08/09/1941	Moose Lake	Cutthroat Ylst	3,492	0.0	0.00	5	Park	04N11E29
06/20/1941	Muddy Creek	Brook Trout	16,500	2.0	0.00	3	Park	03N08E13
06/24/1941	Muddy Creek	Brook Trout	20,800	2.0	0.00	3	Park	03N08E13
05/19/1942	Muddy Creek	Brown Trout	5,000	2.0	0.00	3	Park	03N08E13

06/17/1943	Muddy Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N08E13
06/19/1946	Muddy Creek	Brown Trout		35,000	2.0	0.00	3	Park	03N08E13
05/07/1942	N Fk Elk Creek	Brown Trout		10,000	2.0	0.00	3	Park	04N09E33
05/21/1943	N Fk Elk Creek	Brown Trout		5,000	2.0	0.00	3	Park	04N09E33
06/12/1944	N Fk Elk Creek	Brown Trout		10,000	2.0	0.00	3	Park	04N09E33
06/28/1945	N Fk Elk Creek	Brown Trout		5,000	3.0	0.00	3	Park	04N09E33
07/07/1948	N Fk Elk Creek	Brown Trout		12,000	2.0	0.00	3	Park	04N09E33
09/11/1951	N Fk Elk Creek	Cutthroat Trout		4,000	2.0	0.00	3	Park	04N09E33
05/26/1953	N Fk Elk Creek	Brook Trout		10,000	1.0	10.00	3	Park	04N09E33
05/18/1954	N Fk Elk Creek	Brook Trout		6,000	1.0	9.00	3	Park	04N09E33
09/02/1938	N Fk Horse Creek	Cutthroat Ylst		10,560	0.0	0.00	3	Park	03N10E19
05/07/1942	N Fk Horse Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N10E19
05/21/1943	N Fk Horse Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N10E19
06/12/1944	N Fk Horse Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N10E19
06/28/1945	N Fk Horse Creek	Brown Trout		10,000	3.0	0.00	3	Park	03N10E19
07/25/1946	N Fk Horse Creek	Brown Trout		15,000	2.0	0.00	3	Park	03N10E19
06/05/1947	N Fk Horse Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N10E19
07/06/1948	N Fk Horse Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N10E19
06/13/1950	N Fk Horse Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N10E19
06/13/1950	N Fk Horse Creek	Brown Trout		5,000	2.0	0.00	3	Park	03N10E19
07/29/1941	N Fk Willow Creek	Cutthroat Ylst		3,680	4.0	0.00	3	Park	01S10E00
08/18/1938	North Fork Lake	Cutthroat Ylst		22,350	0.0	0.00	5	Park	04N11E08
07/17/1949	North Fork Lake	Rainbow Trout		10,000	2.0	0.00	5	Park	04N11E08
09/10/1936	Pear Lake	Rainbow Trout		10,000	2.0	0.00	5	Park	03N11E12
09/28/1976	Pear Lake	Rainbow Trout	L	4,188	2.0	12.00	5	Park	03N11E12
08/24/1978	Pear Lake	Rainbow Trout	A	2,025	5.0	75.00	5	Park	03N11E12
08/18/1984	Pear Lake	Rainbow Trout	D	4,032	3.0	32.00	5	Park	03N11E12
07/28/1992	Pear Lake	Rainbow Trout	D	4,055	1.7	8.00	5	Park	03N11E12
09/13/2000	Pear Lake	Rainbow Trout	D	3,980	2.0	12.06	5	Park	03N11E12
10/25/1933	Porcupine Creek	Cutthroat Trout		15,000	0.0	0.00	3	Park	04N09E21
07/27/1938	Porcupine Creek	Brook Trout		6,200	3.0	0.00	3	Park	04N09E21
06/15/1940	Porcupine Creek	Brook Trout		6,000	2.0	0.00	3	Park	04N09E21
06/20/1940	Porcupine Creek	Brook Trout		17,200	2.0	0.00	3	Park	04N09E21
08/12/1940	Porcupine Creek	Brook Trout		3,800	4.0	0.00	3	Park	04N09E21
06/26/1941	Porcupine Creek	Brook Trout		20,800	2.0	0.00	3	Park	04N09E21
05/07/1942	Porcupine Creek	Brown Trout		10,000	2.0	0.00	3	Park	04N09E21
05/21/1943	Porcupine Creek	Brown Trout		10,000	2.0	0.00	3	Park	04N09E21
06/12/1944	Porcupine Creek	Brown Trout		15,000	2.0	0.00	3	Park	04N09E21
07/05/1945	Porcupine Creek	Brown Trout		9,000	2.0	0.00	3	Park	04N09E21
09/19/1946	Porcupine Creek	Cutthroat Trout		10,000	2.0	0.00	3	Park	04N09E21
07/22/1949	Porcupine Creek	Cutthroat Trout		6,000	3.0	0.00	3	Park	04N09E21
06/27/1950	Porcupine Creek	Brook Trout		2,000	2.0	0.00	3	Park	04N09E21
09/18/1950	Porcupine Creek	Cutthroat Trout		15,000	1.0	0.00	3	Park	04N09E21
09/11/1951	Porcupine Creek	Cutthroat Trout		10,000	2.0	0.00	3	Park	04N09E21
09/17/1951	Porcupine Creek	Brook Trout		2,000	3.0	27.00	3	Park	04N09E21
06/10/1952	Porcupine Creek	Brook Trout		19,000	2.0	0.00	3	Park	04N09E21
05/26/1953	Porcupine Creek	Brook Trout		10,000	1.0	10.00	3	Park	04N09E21
06/02/1953	Porcupine Creek	Brook Trout		30,720	1.0	30.00	3	Park	04N09E21
05/18/1954	Porcupine Creek	Brook Trout		10,000	1.0	18.00	3	Park	04N09E21
08/15/1928	Rock Creek	Cutthroat Trout		48,000	1.0	0.00	3	Park	01N09E11
10/05/1932	Rock Creek	Cutthroat Trout		45,500	0.0	0.00	3	Park	01N09E11
09/13/1936	Rock Creek	Cutthroat Ylst		18,560	0.0	0.00	3	Park	01N09E11
07/24/1946	Rock Creek	Brown Trout		25,000	2.0	0.00	3	Park	01N09E11
09/10/1949	Rock Creek	Cutthroat Trout		25,000	1.0	0.00	3	Park	01N09E11
09/12/1951	Rock Creek	Cutthroat Trout		25,000	1.0	0.00	3	Park	01N09E11
09/08/1952	Rock Creek	Cutthroat Trout		25,000	1.0	0.00	3	Park	01N09E11
09/20/1954	Rock Creek	Cutthroat Trout		25,000	1.0	21.00	3	Park	01N09E11
09/27/1954	Rock Creek	Cutthroat Trout		15,000	1.0	15.00	3	Park	01N09E11
09/22/1935	Rock Lake	Rainbow Trout		8,000	2.0	0.00	3	Park	03N11E11
09/11/1947	Rock Lake	Cutthroat Trout		11,700	0.0	0.00	3	Park	03N11E11
08/19/1963	Rock Lake	Cutthroat Trout		2,500	3.0	25.00	3	Park	03N11E11
08/19/1963	Rock Lake	Cutthroat Trout		2,500	3.0	25.00	3	Park	03N11E11
08/24/1978	Rock Lake	Cutthroat Ylst	M	1,500	2.0	5.00	3	Park	03N11E11
08/06/1981	Rock Lake	Cutthroat Ylst	M	1,511	2.0	5.00	3	Park	03N11E11
08/02/1983	Rock Lake	Cutthroat Ylst	M	2,538	2.0	15.00	3	Park	03N11E11
08/08/1989	Rock Lake	Cutthroat Ylst	M	2,500	2.0	6.50 0	3	Park	03N11E11
08/10/1993	Rock Lake	Cutthroat Ylst	M	2,500	2.2	9.26 0	3	Park	03N11E11
07/21/1995	Rock Lake	Cutthroat Ylst	M	2,500	1.9	5.46 0	5	Park	03N11E11
08/06/2001	Rock Lake	Cutthroat Ylst	M	2,500	2.0	6.82 0	5	Park	03N11E11
05/07/1942	S Fk Elk Creek	Brown Trout		5,000	2.0	0.00	3	Park	04N09E33

05/21/1943	S Fk Elk Creek	Brown Trout		5,000	2.0	0.00		3 Park	04N09E33
06/12/1944	S Fk Elk Creek	Brown Trout		5,000	2.0	0.00		3 Park	04N09E33
06/28/1945	S Fk Elk Creek	Brown Trout		5,000	3.0	0.00		3 Park	04N09E33
05/26/1931	S Fk Horse Creek	Cutthroat Trout		8,800	4.0	0.00		3 Park	03N09E24
07/22/1936	S Fk Horse Creek	Cutthroat Ylst		12,000	0.0	0.00		3 Park	03N09E24
07/29/1940	S Fk Horse Creek	Rainbow Trout		21,000	0.0	0.00		3 Park	03N09E24
08/04/1941	S Fk Horse Creek	Rainbow Trout		5,240	0.0	0.00		3 Park	03N09E24
05/07/1942	S Fk Horse Creek	Brown Trout		5,000	2.0	0.00		3 Park	03N09E24
08/04/1942	S Fk Horse Creek	Rainbow Trout		25,000	2.0	0.00		3 Park	03N09E24
05/21/1943	S Fk Horse Creek	Brown Trout		5,000	2.0	0.00		3 Park	03N09E24
09/10/1943	S Fk Horse Creek	Rainbow Trout		10,000	2.0	0.00		3 Park	03N09E24
06/12/1944	S Fk Horse Creek	Brown Trout		5,000	2.0	0.00		3 Park	03N09E24
09/02/1944	S Fk Horse Creek	Rainbow Trout		18,000	2.0	0.00		3 Park	03N09E24
07/05/1945	S Fk Horse Creek	Brown Trout		10,000	2.0	0.00		3 Park	03N09E24
06/06/1947	S Fk Horse Creek	Brown Trout		10,000	2.0	0.00		3 Park	03N09E24
09/19/1950	S Fk Horse Creek	Cutthroat Trout		5,000	1.0	0.00		3 Park	03N09E24
08/09/1951	S Fk Horse Creek	Rainbow Trout		4,000	4.0	0.00		3 Park	03N09E24
09/12/1951	S Fk Horse Creek	Cutthroat Trout		10,000	1.0	0.00		3 Park	03N09E24
09/13/1951	S Fk Horse Creek	Cutthroat Trout		5,000	1.0	0.00		3 Park	03N09E24
07/13/1952	S Fk Horse Creek	Rainbow Trout		4,275	3.0	0.00		3 Park	03N09E24
09/09/1952	S Fk Horse Creek	Cutthroat Trout		5,000	1.0	0.00		3 Park	03N09E24
09/17/1941	S Fk Shields River	Cutthroat Ylst		10,000	0.0	0.00		3 Park	05N10E28
08/27/1942	S Fk Shields River	Cutthroat Ylst		5,000	2.0	0.00		3 Park	05N10E28
09/08/1944	S Fk Shields River	Cutthroat Ylst		10,000	2.0	0.00		3 Park	05N10E28
09/24/1945	S Fk Shields River	Cutthroat Trout		10,000	2.0	0.00		3 Park	05N10E28
06/06/1947	S Fk Shields River	Brown Trout		15,000	2.0	0.00		3 Park	05N10E28
09/09/1949	S Fk Shields River	Cutthroat Trout		10,000	1.0	0.00		3 Park	05N10E28
09/23/1954	S Fk Shields River	Cutthroat Trout		11,900	1.0	10.00		3 Park	05N10E28
08/16/1946	S Fk Willow Creek	Cutthroat Trout		3,152	4.0	0.00		3 Park	01S10E00
09/16/1941	Scofield Creek	Cutthroat Ylst		4,200	0.0	0.00		3 Park	05N11E16
08/26/1942	Scofield Creek	Cutthroat Ylst		4,000	2.0	0.00		3 Park	05N11E16
10/05/1943	Scofield Creek	Cutthroat Ylst		5,000	2.0	0.00		3 Park	05N11E16
09/07/1944	Scofield Creek	Cutthroat Ylst		5,000	2.0	0.00		3 Park	05N11E16
09/11/1936	Smeller Creek	Cutthroat Ylst		13,920	0.0	0.00		3 Park	02N10E00
09/08/1938	Smeller Creek	Cutthroat Ylst		21,550	0.0	0.00		3 Park	02N10E00
09/22/1935	Smeller Lake	Rainbow Trout		8,000	2.0	0.00		3 Park	03N11E13
08/30/1940	Smeller Lake	Cutthroat Ylst		10,080	0.0	0.00		3 Park	03N11E13
08/19/1963	Smeller Lake	Cutthroat Trout		1,100	3.0	12.00		3 Park	03N11E13
07/31/1969	Smeller Lake	Cutthroat Ylst		1,045	3.0	11.00		3 Park	03N11E13
07/29/1972	Smeller Lake	Cutthroat Ylst		1,536	3.0	24.00		3 Park	03N11E13
08/11/1976	Smeller Lake	Cutthroat Ylst	M	1,064	2.0	4.00		3 Park	03N11E13
07/17/1979	Smeller Lake	Cutthroat Ylst	M	1,010	2.0	3.00		3 Park	03N11E13
08/21/1984	Smeller Lake	Cutthroat Ylst	M	1,100	2.0	2.00		3 Park	03N11E13
08/02/1988	Smeller Lake	Cutthroat Ylst	M	1,104	2.0	3.00	0	3 Park	03N11E13
07/29/1992	Smeller Lake	Cutthroat Ylst	M	1,100	1.9	2.55	0	3 Park	03N11E13
08/13/1996	Smeller Lake	Cutthroat Ylst	M	1,100	2.3	4.61	0	5 Park	03N11E13
09/13/2000	Smeller Lake	Cutthroat Ylst	M	1,100	2.5	5.63	0	5 Park	03N11E13
07/22/1936	Smith Creek	Cutthroat Ylst		46,040	0.0	0.00		3 Park	05N09E00
08/26/1942	Smith Creek	Cutthroat Ylst		8,000	2.0	0.00		3 Park	05N09E00
09/15/1943	Smith Creek	Cutthroat Ylst		17,000	2.0	0.00		3 Park	05N09E00
09/25/1945	Smith Creek	Cutthroat Trout		10,000	2.0	0.00		3 Park	05N09E00
09/25/1945	Smith Creek	Cutthroat Trout		5,000	2.0	0.00		3 Park	05N09E00
09/19/1946	Smith Creek	Cutthroat Trout		10,000	2.0	0.00		3 Park	05N09E00
09/09/1948	Smith Creek	Cutthroat Trout		10,000	0.0	0.00		3 Park	05N09E00
09/09/1949	Smith Creek	Cutthroat Trout		10,000	1.0	0.00		3 Park	05N09E00
09/25/1950	Smith Creek	Cutthroat Trout		10,000	1.0	0.00		3 Park	05N09E00
09/13/1951	Smith Creek	Cutthroat Trout		12,000	1.0	0.00		3 Park	05N09E00
09/10/1952	Smith Creek	Cutthroat Trout		10,000	1.0	0.00		3 Park	05N09E00
09/23/1954	Smith Creek	Cutthroat Trout		13,100	1.0	11.00		3 Park	05N09E00
09/11/1958	Stoyenoff Reservoir	Cutthroat Trout		10,400	1.0	13.00		3 Park	04N10E19
07/15/1939	Sunlight Creek	Rainbow Trout		4,000	2.0	0.00		3 Park	04N10E00
09/17/1941	Sunlight Creek	Cutthroat Ylst		10,000	0.0	0.00		3 Park	04N10E00
08/27/1942	Sunlight Creek	Cutthroat Ylst		10,000	2.0	0.00		3 Park	04N10E00
10/05/1943	Sunlight Creek	Cutthroat Ylst		6,000	2.0	0.00		3 Park	04N10E00
09/07/1944	Sunlight Creek	Cutthroat Ylst		6,000	2.0	0.00		3 Park	04N10E00
08/20/1939	Sunlight Lake	Cutthroat Trout		25,200	1.0	0.00		5 Park	04N11E08
08/01/1941	Sunlight Lake	Rainbow Trout		22,400	0.0	0.00		5 Park	04N11E08
08/27/1974	Sunlight Lake	Cutthroat Ylst	M	1,440	1.0	1.00		5 Park	04N11E08
08/24/1978	Sunlight Lake	Cutthroat Ylst	M	1,500	2.0	5.00		5 Park	04N11E08
07/28/1982	Sunlight Lake	Cutthroat Ylst	M	1,505	2.0	5.00		5 Park	04N11E08

07/29/1986	Sunlight Lake	Cutthroat Ylst	M	1,050	1.0	1.50	5	Park	04N11E08
08/08/1994	Sunlight Lake	Cutthroat Ylst	M	1,000	2.5	5.19 0	5	Park	04N11E08
08/12/2002	Sunlight Lake	Cutthroat Ylst	M	1,000	2.5	5.11 0	5	Park	04N11E08
09/16/1941	Turkey Creek	Cutthroat Ylst		4,200	0.0	0.00	3	Park	05N11E16
08/26/1942	Turkey Creek	Cutthroat Ylst		4,000	2.0	0.00	3	Park	05N11E16
07/25/1936	Twin Lakes	Brook Trout		5,004	0.0	0.00	5	Park	04N11E36
07/17/1938	Twin Lakes	Rainbow Trout		4,200	0.0	0.00	5	Park	04N11E36
08/28/1944	Twin Lakes	Rainbow Trout		7,776	5.0	0.00	5	Park	04N11E36
08/05/1985	Twin Lakes	Arctic Grayling	R	250	2.0	1.00	5	Park	03N11E02
08/05/1985	Twin Lakes	Arctic Grayling	R	300	2.0	1.00	5	Park	04N11E36
09/12/1991	Twin Lakes	Arctic Grayling	M	680	1.2	0.07	5	Park	03N11E02
09/12/1991	Twin Lakes	Arctic Grayling	M	1,060	1.2	0.12	5	Park	04N11E36
07/29/1992	Twin Lakes	Arctic Grayling	M	1,060	0.9	0.19	5	Park	04N11E36
07/29/1992	Twin Lakes	Arctic Grayling	M	680	0.9	0.12	5	Park	03N11E02
07/19/1939	Willow Creek	Cutthroat Ylst		1,590	5.0	0.00	3	Park	01N10E29
10/16/1944	Willow Creek	Cutthroat Ylst		20,000	2.0	0.00	3	Park	01N10E29

Appendix C. Number (n) of fish from which tissue samples were taken during 2001 and 2002 for genetic analyses from tributaries to the Shields River entering from the west by drainage, stream, km, date, and latitude and longitude.

Drainage	Stream	Km	DATE	n	Latitude	Longitude
Bangtail Creek	BANGTAIL CR	7.90	7/16/2001	5	45.81408	110.6379
Bangtail Creek	BANGTAIL CR	11.26	7/17/2001	5	45.80675	110.6773
Bangtail Creek	BANGTAIL CR	9.65	7/17/2001	5	45.81222	110.6599
Bangtail Creek	BANGTAIL CR	6.44	7/17/2001	5	45.815	110.6281
Bangtail Creek	BANGTAIL CR	12.87	7/17/2001	5	45.80908	110.6957
Brackett Creek	BRACKETT CR	11.60	7/18/2001	6	45.87181	110.7216
Brackett Creek	BRACKETT CR	21.70	7/18/2001	5	45.86275	110.8257
Brackett Creek	BRACKETT CR	6.92	8/2/2001	4	45.86681	110.6693
Brackett Creek	BRACKETT CR	25.10	8/3/2001	5	45.85989	110.8499
Brackett Creek	HORSE CR	1.60	6/27/2001	3	45.87331	110.8282
Brackett Creek	HORSE CR	0.80	6/27/2001	4	45.86722	110.8223
Brackett Creek	M FK BRACKETT CR	1.90	7/19/2001	5	45.85747	110.9096
Brackett Creek	M FK BRACKETT CR	0.10	7/31/2001	5	45.86042	110.8851
Brackett Creek	MILES CR	4.80	6/25/2001	5	45.8415	110.7985
Brackett Creek	MILES CR	3.90	6/25/2001	10	45.84811	110.7918
Brackett Creek	MILES CR	5.80	6/26/2001	4	45.83283	110.8019
Brackett Creek	MILES CR	2.20	6/26/2001	5	45.85742	110.7766
Brackett Creek	MILES CR	3.10	6/26/2001	5	45.85222	110.785
Brackett Creek	N FK BRACKETT CR	1.80	7/18/2002	5	45.87037	110.9022
Brackett Creek	SKUNK CR	3.90	6/27/2001	3	45.83608	110.8336
Brackett Creek	SKUNK CR	2.50	6/27/2001	5	45.84458	110.8252
Brackett Creek	SKUNK CR	1.61	6/27/2001	2	45.85003	110.8168
Brackett Creek	SKUNK CR	0.40	6/27/2001	5	45.8575	110.8012
Brackett Creek	UNNAMED TRIB TO WEASEL CR	0.16	6/27/2001	1	45.85833	110.8392
Canyon Creek	BRIDGMAN CR	0.10	7/6/2001	3	45.84175	110.7387
Canyon Creek	CANYON CR	14.30	7/5/2001	5	45.84264	110.7454
Canyon Creek	CANYON CR	15.80	7/5/2001	5	45.84008	110.7629
Canyon Creek	CANYON CR	17.00	7/5/2001	5	45.83244	110.7719
Canyon Creek	CANYON CR	11.00	7/6/2001	5	45.837	110.7074
Canyon Creek	CANYON CR	12.50	7/6/2001	5	45.84033	110.7238
Canyon Creek	GROUSE CR	1.80	7/5/2001	1	45.83042	110.7586
Canyon Creek	GROUSE CR	0.20	7/5/2001	5	45.84275	110.7464
Chicken Creek	CHICKEN CR	6.30	8/14/2002	5	45.86388	110.5019
Flathead Creek	CACHE CR	4.00	6/28/2001	3	45.92139	110.8661
Flathead Creek	CACHE CR	4.90	6/28/2001	5	45.91459	110.8682
Flathead Creek	CACHE CR	6.30	6/28/2001	5	45.90261	110.8726
Flathead Creek	CACHE CR	7.50	6/28/2001	2	45.89386	110.8805
Flathead Creek	CACHE CR	2.90	8/15/2001	4	45.92925	110.8617

Flathead Creek	CACHE CR	1.00	8/16/2001	5	45.94333	110.8501
Flathead Creek	CARROL CR	5.60	8/28/2001	2	45.94495	110.8831
Flathead Creek	FAIRY CR	2.10	8/16/2001	1	45.96078	110.8441
Flathead Creek	FAIRY CR	5.60	8/30/2001	5	45.93919	110.8691
Flathead Creek	FAIRY CR	7.80	8/30/2001	5	45.92811	110.8891
Flathead Creek	FLATHEAD CR	25.80	8/27/2001	5	45.9722	110.9116
Flathead Creek	FLATHEAD CR	24.40	8/29/2001	5	45.97028	110.895
Flathead Creek	FLATHEAD CR	13.60	8/30/2001	2	45.98778	110.7868
Flathead Creek	FRAZIER CR	0.50	8/28/2001	2	45.96761	110.9125
Flathead Creek	S FK FLATHEAD CR	3.80	8/27/2001	5	45.96294	110.9577
Flathead Creek	S FK FLATHEAD CR	1.80	8/27/2001	4	45.96767	110.9351
Potter Creek	COTTONWOOD CR	17.70	7/11/2002	5	46.19225	110.8099
Potter Creek	COTTONWOOD CR	14.40	7/15/2002	11	46.04447	110.7752
Potter Creek	COTTONWOOD CR	11.30	7/15/2002	4	45.87037	110.7413
Willow Creek	N FK WILLOW CR	7.54	8/14/2001	5	45.78572	110.6898
Willow Creek	N FK WILLOW CR	4.51	8/14/2001	2	45.79083	110.6541
Willow Creek	N FK WILLOW CR	6.19	8/14/2001	3	45.79025	110.6743
Willow Creek	N FK WILLOW CR	9.28	8/14/2001	5	45.78467	110.7109
Willow Creek	N FK WILLOW CR	3.80	8/15/2001	2	45.78983	110.6459
Willow Creek	N FK WILLOW CR	2.70	8/15/2001	5	45.78747	110.6326
Willow Creek	S FK WILLOW CR	1.60	8/13/2001	1	45.76786	110.664
Willow Creek	S FK WILLOW CR	0.10	8/13/2001	2	45.77414	110.6466

Appendix D. Historical genetic samples taken from Shields River tributaries prior to 2000 showing level of purity for Yellowstone cutthroat trout in the sample (% YCT), date of sample, and sample size (n) by stream. Introgress shows the species abbreviation of species that introgressed with Yellowstone cutthroat trout (RB = rainbow trout).

Stream	Tributary to	Date	% YCT	n	Introgress
BANGTAIL CR	SHIELDS R	8/7/1990	100	12	
BENNETT CR	SHIELDS R	8/16/1990	100	10	
BRACKETT CR	SHIELDS R	6/19/1987	100	20	
BRACKETT CR, M FK	BRACKETT CR	7/23/1987	100	21	
BRACKETT CR, N FK	BRACKETT CR	7/23/1987	100	21	
CARROL CR	CACHE CR	9/10/1990	100	19	
CARROL CR, S FK	CARROL CR	8/7/1990	100	11	
COTTONWOOD CR	SHIELDS R	3/22/1999	99.1	32	RB
DAISY DEAN CR	SHIELDS R	10/21/1999	100	25	
DEEP CR	SHIELDS R	7/27/1990	100	10	
DUGOUT CR	SHIELDS R	7/27/1992	100	5	
ELK CR, N FK (mi. 4.8)	ELK CR	7/6/1999	100	44	
ELK CR, N FK (mi. 8.2)	ELK CR	6/30/1993	100	13	
ELK CR, S FK	ELK CR	7/6/1999	99.1	29	RB
FAIRY CR	CACHE CR	8/13/1990	100	3	
FLATHEAD CR	SHIELDS R	9/10/1990	100	9	
FLATHEAD CR, S FK	FLATHEAD CR	7/3/1990	100	7	
HORSE CR	BRACKETT CR	1/1/1993	92.8	9	RB
HORSE CR	SHIELDS R	10/13/1999	100	30	
HORSE CR, M FK	HORSE CR, N FK	8/5/1991	100	5	
HORSE CR, S FK	HORSE CR	8/5/1991	100	7	
LODGEPOLE CR		8/1/1986	100	4	
MILL CR	SHIELDS R	7/27/1990	100	11	
PORCUPINE CR	SHIELDS R	5/5/1999	-[1/]	34	
ROCK CR	SHIELDS R	10/6/1998	100	20	
SCOFIELD CR	SHIELDS R	8/16/1990	100	10	
SHIELDS R, S FK	SHIELDS R	8/10/1992	100	10	
SMITH CR	SHIELDS R	10/20/1988	100	23	
SMITH CR	SHIELDS R	8/10/1992	100	1	
SMITH CR, E FK	SMITH CR	10/20/1988	100	9	
TURKEY CR	SHIELDS R	8/1/1986	100	13	
WILLOW CR, N FK	WILLOW CR	7/23/1993	100	17	

[1/] This sample consisted of 33 fish that had no indication of any introgression and were likely pure YCT, while one fish appeared to be a first-generation hybrid between RBxYCT.

Appendix E. Fish population estimates made in Shields River tributaries from 2001 through 2003 by length group.

RIVER / DRAINAGE / STREAM / Kilometer	Date	Section (m) Length	Width	Estimator	Species	Estimates (S.E.) 0-74 mm	75-149 mm	> 150 mm
SHIELDS								
BANGTAIL CREEK								
BANGTAIL CR								
7.90	7/16/2001	115	2.6	M	EBT	7 (0)	9 (0)	14 (0)
7.90	7/16/2001	115	2.6	M	YCT	0 (0)	4 (0)	4 (0)
BENNETT CREEK								
BENNETT CR								
1.10	6/23/2003	110	3.7	M	YCT	2 (0)	14 (5)	11 (2)
1.20	6/23/2003	105	3.7	M	EBT	0 (0)	2 (0)	0 (0)
1.20	6/23/2003	105	3.7	M	YCT	4 (1)	45 (1)	15 (2)
BRACKETT CREEK								
BRACKETT CR								
6.92	8/2/2001	300	3.0	M	BRT	3 (0)	4 (0)	39 (0)
6.92	8/2/2001	300	3.0	M	LNS	0 (0)	10 (0)	6 (0)
6.92	8/2/2001	300	3.0	M	MWF	0 (0)	1 (0)	2 (0)
6.92	8/2/2001	300	3.0	M	RB	0 (0)	0 (0)	1 (0)
6.92	8/2/2001	300	3.0	M	YCT	0 (0)	0 (0)	4 (0)
11.60	7/18/2001	310	4.0	P	BRT[1/]	-	-	-
11.60	7/18/2001	310	4.0	P	MWF[1/]	-	-	-

RIVER / DRAINAGE / STREAM		Section (m)				Estimates (S.E.)		
Kilometer	Date	Length	Width	Estimator	Species	0-74 mm	75-149 mm	> 150 mm
11.60	7/18/2001	310	4.0	P	YCT[1/]	-	-	-
21.70	7/18/2001	300	4.5	M	BRT	1 (0)	41 (0)	30 (0)
21.70	7/18/2001	300	4.5	M	EBT	0 (0)	1 (0)	3 (0)
21.70	7/18/2001	300	4.5	M	MWF	0 (0)	1 (0)	27 (0)
21.70	7/18/2001	300	4.5	M	YCT	0 (0)	24 (0)	21 (0)
25.10	8/3/2001	300	3.0	M	BRT	1	11 (1)	30 (0)
25.10	8/3/2001	300	3.0	M	EBT	3 (0)	3 (0)	1 (0)
25.10	8/3/2001	300	3.0	M	MWF	0 (0)	0 (0)	19 (0)
25.10	8/3/2001	300	3.0	M	YCT	0 (0)	3 (0)	11 (0)
M FK BRACKETT CR								
0.10	7/31/2001	300	2.0	M	BRT	0 (0)	3 (0)	4 (0)
0.10	7/31/2001	300	2.0	M	EBT	11 (0)	22 (0)	33 (0)
0.10	7/31/2001	300	2.0	M	MWF	0 (0)	0 (0)	17 (0)
0.10	7/31/2001	300	2.0	M	YCT	0 (0)	14 (0)	15 (0)

RIVER / DRAINAGE / STREAM	Kilometer	Date	Section (m) Length	Width	Estimator	Species	Estimates (S.E.) 0-74 mm	75-149 mm	> 150 mm
	1.90	7/19/2001	300	2.5	M	EBT	8 (0)	88 (8)	26 (1)
	1.90	7/19/2001	300	2.5	M	YCT	10 (0)	-	6 (0)
MILES CR									
	3.90	6/25/2001	75	2.2	M	YCT	0 (0)	8 (0)	4 (0)
N FK BRACKETT CR									
	1.80	7/18/2002	100	3.4	M	EBT	0 (0)	26 (0)	28 (0)
	1.80	7/18/2002	100	3.4	M	YCT	1 (0)	2 (0)	2 (0)
CANYON CREEK									
CANYON CR									
	11.00	7/6/2001	100	2.9	M	BRT	0 (0)	0 (0)	6 (0)
	11.00	7/6/2001	100	2.9	M	EBT	1 (0)	0 (0)	0 (0)
	11.00	7/6/2001	100	2.9	M	YCT	0 (0)	11 (0)	7 (0)
	14.30	7/5/2001	75	2.1	M	BRT	0 (0)	0 (0)	1 (0)
	14.30	7/5/2001	75	2.1	M	EBT	2 (0)	4 (0)	5 (0)
	14.30	7/5/2001	75	2.1	M	YCT	1	8 (0)	7 (0)
GROUSE CR									
	0.20	7/5/2001	75	2.0	M	EBT	0 (0)	3 (0)	-

RIVER / DRAINAGE / STREAM	Kilometer	Date	Section (m) Length	Width	Estimator	Species	Estimates (S.E.) 0-74 mm	75-149 mm	> 150 mm
	0.20	7/5/2001	75	2.0	M	YCT	4 (0)	8 (0)	2 (0)
CHICKEN CREEK / CHICKEN CR	6.30	8/14/2002	75	1.5	M	YCT	0 (0)	5 (0)	0 (0)
COTTONWOOD CREEK / COTTONWOOD CR	17.60	7/9/2003	300	7.2	M	EBT	0 (0)	23 (30)	2 (0)
	17.60	7/9/2003	300	7.2	M	YCT	2 (0)	17 (1)	2 (0)
DEEP CREEK / DEEP CR	2.00	7/2/2003	150	4.3	M	EBT	0 (0)	10 (0)	21 (1)
	2.00	7/2/2003	150	4.3	M	YCT	0 (0)	2 (0)	2 (0)
DUGOUT CREEK / DUGOUT CR	0.30	6/30/2003	150	2.9	M	YCT	0 (0)	5 (0)	5 (0)
FLATHEAD CREEK / CACHE CR	1.00	8/16/2001	100	3.8	M	BRT	12 (0)	7 (0)	11 (1)
	1.00	8/16/2001	100	3.8	M	EBT	2 (0)	3 (0)	5 (0)
	1.00	8/16/2001	100	3.8	M	YCT	0 (0)	9 (1)	3 (0)
	6.30	6/28/2001	100	3.0	M	EBT	0 (0)	7 (0)	7 (0)

RIVER / DRAINAGE / STREAM	Kilometer	Date	Section (m) Length	Width	Estimator	Species	Estimates (S.E.) 0-74 mm	75-149 mm	> 150 mm
	6.30	6/28/2001	100	3.0	M	YCT	4 (0)	10 (0)	4 (0)
CARROL CR									
	5.60	8/28/2001	100	2.0	M	EBT	3 (0)	10 (0)	36 (1)
	5.60	8/28/2001	100	2.0	M	YCT	0 (0)	1 (0)	1 (0)
FAIRY CR									
	5.60	8/30/2001	75	1.7	M	YCT	7 (0)	6 (0)	0 (0)
FLATHEAD CR									
	25.80	8/27/2001	100	2.8	M	EBT	3 (0)	17 (0)	11 (0)
	25.80	8/27/2001	100	2.8	M	YCT	6 (0)	2 (0)	7 (0)
S FK FLATHEAD CR									
	3.80	8/27/2001	100	1.7	M	YCT	4 (0)	9 (0)	0 (0)
MILL CREEK									
MILL CR									
	0.10	6/24/2003	100	1.8	M	EBT	0 (0)	2 (0)	2 (0)
	0.10	6/24/2003	100	1.8	M	YCT	1	4 (0)	2 (0)
	0.20	6/24/2003	100	1.8	M	EBT	0 (0)	6 (0)	6 (0)
	0.20	6/24/2003	100	1.8	M	YCT	0 (0)	11 (0)	1 (0)
POTTER CREEK									
COTTONWOOD CR									

RIVER / DRAINAGE / STREAM / Kilometer	Date	Section (m) Length	Width	Estimator	Species	Estimates (S.E.) 0-74 mm	75-149 mm	> 150 mm
11.70	7/11/2002	100	2.3	M	YCT	0 (0)	3 (0)	3 (0)
14.40	7/15/2002	100	2.3	M	YCT	0 (0)	9 (0)	2 (0)
17.60	7/11/2002	100	1.6	M	YCT	0 (0)	6 (0)	3 (0)
ROCK CREEK / ROCK CR								
6.15	7/10/2003	205	4.2	M	BRT	0 (0)	-	24 (0)
15.40	7/15/2003	103	9.5	M	BRT	0 (0)	2 (0)	5 (1)
15.40	7/15/2003	103	9.5	M	EBT	0 (0)	6 (1)	4 (0)
15.40	7/15/2003	103	9.5	M	YCT	1 (0)	2 (0)	2 (0)
15.50	7/15/2003	105	9.5	M	BRT	0 (0)	-	3 (0)
15.50	7/15/2003	105	9.5	M	EBT	1 (0)	5 (0)	8 (0)
15.50	7/15/2003	105	9.5	M	YCT	0 (0)	1 (0)	1
SCOFIELD CREEK / SCOFIELD CR								
0.70	6/25/2003	100	1.7	M	YCT	0 (0)	6 (0)	1 (0)
0.80	6/25/2003	100	1.7	M	YCT	0 (0)	15 (3)	1 (1)
SOUTH FORK SHIELDS RIVER / S FORK SHIELDS								

RIVER / DRAINAGE / STREAM	Kilometer	Date	Section (m) Length	Width	Estimator	Species	Estimates (S.E.) 0-74 mm	75-149 mm	> 150 mm
	0.10	7/8/2003	100	2.4	M	EBT	1 (0)	7 (0)	2 (0)
	0.10	7/8/2003	100	2.4	M	YCT	0 (0)	3 (0)	0 (0)
	0.20	7/8/2003	100	2.4	M	BRT	0 (0)	0 (0)	2 (0)
	0.20	7/8/2003	100	2.4	M	EBT	1 (0)	8 (0)	5 (1)
	0.20	7/8/2003	100	2.4	M	YCT	0 (0)	5 (1)	1 (0)
SMITH CREEK									
SMITH CR	6.10	7/17/2003	200	5.2	M	EBT	2 (0)	7 (0)	14 (0)
	6.10	7/17/2003	200	5.2	M	YCT	1 (0)	20 (0)	9 (0)
	8.20	6/26/2003	105	4.1	M	EBT	2 (0)	17 (0)	6 (0)
	8.20	6/26/2003	105	4.1	M	YCT	2 (0)	4 (0)	2 (0)
	8.30	6/26/2003	200	4.1	M	EBT	0 (0)	13 (1)	7 (0)
	8.30	6/26/2003	200	4.1	M	YCT	1 (0)	3 (0)	1 (0)
TURKEY CREEK									
TURKEY CR	0.50	6/25/2003	100	1.7	M	YCT	0 (0)	5 (0)	2 (0)

RIVER / DRAINAGE / STREAM / Kilometer	Date	Section (m) Length	Width	Estimator	Species	Estimates (S.E.) 0-74 mm	75-149 mm	> 150 mm
WILLOW CREEK / N FK WILLOW CR / 4.51	8/14/2001	75	1.9	M	YCT	1 (0)	3 (0)	2 (0)
9.28	8/14/2001	75	2.5	M	YCT	4	23	6

[1/] No estimates were made for individual size groups in this section as estimates were made by mark-recapture estimates.

Appendix F. Angling pressure on selected tributaries to the Shields River from Montana's statewide mail-card creel survey (McFarland and Meredith 2002)

Angling pressure estimated in the Shields River drainage from 1982 to 2001 from Montana 's MFISH database (http://nris.state.mt.us/scripts/esrimap.dll?name=MFISH&Cmd= INST&WCmd=Stream).

Year	Total Pressure	Total Trips	Resident Pressure	Resident Trips	Non-Resident Pressure	Non-Resident Trips
2001	3,999	76	2,963	56	1,036	20
1999	4,232	106	3,358	83	874	23
1997	4,986	134	3,808	99	1,178	35
1995	5,429	135	3,930	96	1,499	39
1993	4,742	128	3,293	84	1,449	44
1991	3,986	110	3,518	97	468	13
1989	4,088	82	3,013	54	1,075	28
1985	3,940	26	3,294	18	646	8
1984	3,508	16	2,657	6	851	10
1983	2,545	21	1,658	8	887	13
1982	6,367	40	5,319	33	1,048	7

Angling pressure estimated in Bangtail Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
93	146	124	4	146	124	4	0	0	0	835	178
95	44	44	1	44	44	1	0	0	0	1450	324
97	23	23	1	23	23	1	0	0	0	1865	453

Angling pressure estimated in Brackett Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
82	2183	1356	12	2183	1356	12	0	0	0	207	47

83	956	410	8	615	355	3	341	205	5	353	70
85	697	338	7	629	331	6	68	68	1	382	84
89	143	84	3	107	76	2	36	36	1	866	189
91	393	154	12	393	154	12	0	0	0	461	96
93	354	131	12	204	92	6	150	94	6	497	102
95	1142	744	28	1066	740	27	76	76	1	254	51
97	459	172	14	324	151	10	135	82	4	458	91
99	276	180	7	124	96	3	152	152	4	620	132

Angling pressure estimated in North Fork Brackett Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
85	824	824	3	824	824	3	0	0	0	343	79

Angling pressure estimated in Cache Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
91	49	35	2	0	0	0	49	35	2	1412	329
97	69	49	2	69	49	2	0	0	0	1294	289

Angling pressure estimated in Canyon Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
91	111	111	3	111	111	3	0	0	0	976	233

Angling pressure estimated in Carrol Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
99	102	102	3	102	102	3	0	0	0	1027	229

Angling pressure estimated in Fairy Creek from 1982 to 1999 from Montana Rivers Information System.

	Total			Resident			Non Resident		Ranking		
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
99	45	45	1	45	45	1	0	0	0	1438	326

Angling pressure estimated in Flathead Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
85	209	148	2	209	148	2	0	0	0	819	186
91	32	32	1	32	32	1	0	0	0	1736	397
93	40	40	1	40	40	1	0	0	0	1493	354
97	135	106	4	0	0	0	135	106	4	941	202
99	299	179	8	299	179	8	0	0	0	594	128

Angling pressure estimated in Fox Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
89	55	55	1	55	55	1	0	0	0	1389	331

Angling pressure estimated in North Fork of Horse Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
89	60	60	1	60	60	1	0	0	0	1232	285
95	88	88	2	88	88	2	0	0	0	1119	236
97	89	89	3	89	89	3	0	0	0	1149	257

Angling pressure estimated in South Fork of Horse Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
84	85	85	1	0	0	0	85	85	1	753	141
85	105	105	1	105	105	1	0	0	0	930	218
89	72	72	2	0	0	0	72	72	2	1176	266
93	227	203	6	227	203	6	0	0	0	656	134
95	93	93	3	0	0	0	93	93	3	1084	223
99	285	222	7	209	209	5	76	76	2	609	130

Angling pressure estimated in Miles Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
93	173	173	4	173	173	4	0	0	0	746	159
97	138	138	4	138	138	4	0	0	0	923	198

Angling pressure estimated in Willow Creek from 1982 to 1999 from Montana Rivers Information System.

		Total			Resident			Non Resident		Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
91	64	64	2	64	64	2	0	0	0	1322	305
93	50	36	2	50	36	2	0	0	0	1372	316